

# WOOD PRESERVATION IN CANADA - 2006

by

Paul I Morris PhD and Jieying Wang PhD  
Group Leader and Wood Treatment Scientist respectively  
Durability and Protection Group  
Forintek Canada Corp\*.

## Abstract

This paper provides an overview of the Canadian wood preservation sector, including biodeterioration issues in Canada, wood preservation plants, preservatives, wood species, treatment processes, treated wood products, relevant organizations, research topics and the regulatory arena.

Brown-rot fungi are the most economically important agent of biodeterioration in Canada and some regions of Canada have climatic conditions highly conducive to decay. Termites are a regional issue in southern Ontario, and around the Georgia strait and Okanagan in BC.

In 1999, the most recent year for which we have data, 66 treating plants with a total cylinder volume of around 4025 m<sup>3</sup> produced 3.5 million cubic metres of treated wood. About 83% of this volume was treated with water-borne preservatives and 17% with oil-borne preservatives. Since 2003 the industry has moved from CCA to Alkaline copper quat, and copper azole for most residential treated products with no apparent reduction in sales volume. Chromated copper arsenate, pentachlorophenol and creosote are still used for industrial products. The predominant species-group treated is spruce-pine-fir or segregated pines from within this group. Around 10% of production was exported. Borates are now being used on a small scale for interior applications protected from liquid water.

Canada has its own wood preservation standards, supports several technical and marketing organizations and maintains a lead position in certain areas of wood preservation research. A major focus of the industry recently, and for the immediate future, has been the increasing levels of health and environmental protection regulations. The responsiveness of the industry to these regulations has resulted in the continued use of CCA for industrial applications and a shift to ACQ and CA for most residential applications.

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## Introduction

The status of wood preservation in Canada has previously been reviewed by Ruddick (1982) and Morris (1999), but there has been considerable progress in the industry in the last seven years. For the sake of brevity, this paper will be confined to heavy-duty wood preservation and will not cover millwork (joinery) treatment, anti-sapstain treatments or in-process treatments for engineered wood products. It is designed to provide a broad overview of the subject including: biodeterioration issues in Canada, wood preservation plants, preservatives, wood species, treatment processes, treated wood products, relevant organizations, research topics and the regulatory arena.

As in 1999 (Morris 1999), the wood preservation sector in Canada is still an industry in transition. After a period of dramatic growth in the 1970s and 1980s it now services a mature market. During the 1990s the slim profit margins on which the industry operated severely limited the availability of capital for research, technological upgrading, or promotion. This changed somewhat with the shift to new preservative systems. The industry has, been highly responsive to the continued challenge of human health- and environment-related regulations. While necessary for the continued operation of the industry, these new regulations have tied up much of the time, energy and capital that might have fueled progress in other areas. The industry still needs to evolve but is reluctant to depart from the tried and tested, or to adopt new technologies that may add cost without providing a significant competitive advantage.

## **Biodeterioration Problems**

Canada's wood deterioration problems are caused mainly by wood-rotting basidiomycetes and weathering. Insect damage is a concern only in localized areas. Marine borers, including Teredinids and *Limnoria* species, are active on all coasts, but they are more easily controlled by preservative treatment than the borers of southerly waters.

Softwoods are the major structural materials thus brown-rot fungi are the most economically important agent of biodeterioration in Canada. There has been no attempt systematically to determine the most common basidiomycetes on wood in service in Canada. However, experience suggests the Canadian list has much in common with the list developed for the United States (Duncan and Lombard 1965). These are: *Meruliporia incrassata*, *Gloeophyllum trabeum*, *Tapinella panuoides*, *Antrodia vaillantii*, *Coniophora puteana*, *Serpula lacrymans*, *Postia placenta* and *Antrodia serialis*. To these, we should add *Gloeophyllum sepiarium*. All of these are brown-rot fungi and two of them, *M. incrassata* and *S. lacrymans*, have the capability to transport water from wet wood to relatively dry wood over inert surfaces.

Soft-rot fungi are the main organisms ultimately limiting the performance of well-treated wood in ground contact, but they are not as serious a problem in the treated softwoods used in Canada as they are in treated hardwoods used in other countries.

Most of Canada has a continental climate with very cold winters and very warm summers with most of the precipitation falling in the summer. While decay fungi may be dormant in winter, they more than make up for this in summer, particularly in ground contact where moisture is not a limiting factor. The Maritime Provinces on the East coast have a wet climate but low temperatures limit the rate of decay. In the West, coastal British Columbia (BC) has a temperate rainforest climate that is conducive to decay for most of the year. Most of Canada's major population centers fall into the zone of moderate above ground decay hazard (Figure 1) according to the Scheffer index (Setliff 1986). While wood stands up well to the heat and cold of continental Canada, it does suffer from weathering caused by ultraviolet light, rainfall and black-stain fungi, particularly in coastal climates.

Insects tend to cause problems only in localized regions of Canada. Carpenter ants and damp-wood termites may be a nuisance but they are readily controlled by eliminating the rotten wood in which they make their home. Subterranean termites are at the northerly limits of their range in the islands and coasts of the Georgia Strait, BC, the Southern Interior of BC and in Southern Ontario. In BC, *Reticulitermes hesperus* Banks is not regarded as a serious problem, but in certain areas of southern Ontario *Reticulitermes flavipes* Kollar can cause more serious damage. Wood-boring beetles are generally not a major concern for wood in service. Beetle damage to live trees is a common

problem in Canadian forests and the mountain pine beetle is currently killing much of the lodgepole pine forest in BC.

Perhaps the most unfortunate cause of wood decay in this country is the use of non-durable wood under conditions conducive to decay. This likely results from Canada's historic bounty of forest resources. Until recently, wood was plentiful and cheap, and naturally durable cedars were used in exterior applications. As western red cedar lumber became expensive, and limited in supply, treated wood of non-durable species captured much of the market. However untreated non-durable woods have also been used increasingly for outdoor applications. Decay of this material has been exacerbated by newer building designs, which trap rainfall and expose wood to direct rain. The result has been premature decay of wood products, readily predictable by wood scientists, but surprising to the users of wood. In the past, similar changes in other countries caused the development and widespread use of preservative treated wood. In the UK, for example, oak was already in short supply in the 18th century, leading to the development of pressure treatment in the early 1800s. In Australia and New Zealand, naturally durable woods began to run out in the 1950s and preservative treatment of plantation-grown softwoods took over. However, neither of those periods in history was renowned for concern over the use of chemicals. Today, we live in a time of greater awareness of the potential for damage to the environment. There is a desire to avoid the use of pesticides where possible and to use the most benign pesticide in the least amounts where necessary. On the other hand, there is a desire to make wood products last longer to offset their higher cost and ensure sufficient time to grow the wood needed for eventual replacement. The combination of application errors with conflicting opinions on chemical preservation creates a major challenge for scientists and designers in ensuring the durability of wood structures.

### **The Development of the Preservation Industry**

As with most other industrialized countries, Canada's wood preservation industry initially developed using creosote to service the needs of the railroads first, and the utilities second. Creosoted railroad ties and utility poles were the main products up to the 1960s. However, in the early 1970s, the rise of suburbia led to a shift in summer living from the front porch (protected by a roof) to the backyard deck, fully exposed to the elements. A trend for garden structures swept up from the USA, bringing a broad range of residential applications for wood treated with water-borne preservatives. These applications are now covered by the term "consumer lumber." The primary advantages of the water-borne preservatives were their non-oily surface and their claimed freedom from maintenance. In one respect, they met the description "maintenance free," in that the dominant preservative in this market, chromated copper arsenate (CCA), was highly effective in reducing damage caused by ultraviolet light. This was an unexpected bonus of using copper as a biocide and chromium as a fixative. However, it did not protect against the splitting and checking caused by alternate wetting and drying in less stable wood species. This was less of a problem in Canada than the USA because many of our species have better inherent dimensional stability than the southern pine predominantly used in the USA. Nevertheless, water-repellant surface finishes for decks have become extremely popular.

### **Preservatives Currently in Use**

In terms of preservative usage in Canada, the best information we have comes from a report using 1999 data (Stephens, *et al.* 2001). About 17% of the total production was treated with oil-borne preservatives and 83% with water-borne preservatives. No further surveys have been conducted but input from industry analysts suggests production volumes have remained unchanged through the transition from CCA to alternative water-borne preservatives.

The use of Creosote in Canada peaked in the late 1940s and early 1950s. It is still used, mainly for railroad ties and marine structures, with some utility poles for export, but the volumes are at historic lows and declining. In 1999, Canada industry treated 206,593 m<sup>3</sup> wood products with creosote and creosote/petroleum mixtures (Stephens, *et al.* 2001).

Pentachlorophenol in P9 type A oil (Penta) took over from creosote as the main preservative for utility poles in the 1970s, but CCA made substantial inroads into this market during the 1980s. Penta usage remained fairly stable during the early 1990s. In 1999, the Canada industry treated 143,520 m<sup>3</sup> of wood products with Penta (Stephens, *et al.* 2001).

There is only one treating plant using ammoniacal copper zinc arsenate (ACZA) in Canada and no production data are available. ACZA is primarily used on large dimension wood products, such as piling and bridge timbers made from Douglas fir, which is relatively difficult to treat. The ammonia, and the ability to heat the solution, assists with preservative penetration.

The sharp rise in CCA usage in Canada during the 1970s and 80s mirrored that in the USA. Consumption reached a peak in 1990, then leveled off and climbed slowly since that time. In 1999, 3117,57 m<sup>3</sup> of wood products were treated with CCA. Only one formulation, type C oxide, is used and this has been the case for decades. Polyethylene glycol and oil emulsions are used as additives to CCA solutions for treatment of poles to soften the surface for climbing. In 2003 the Canadian preservatives suppliers, subsidiaries of US companies, followed the US lead in agreeing to eliminate most residential uses of CCA from January 2004. Continuing registered uses for CCA include: utility poles, wood foundations, farm fence posts, shingles/shakes, and plywood.

Since 2003, industry observers estimate roughly 80% of CCA usage has been replaced by ACQ and CA. The formulations used in Canada are ACQ type C and CA type B, both amine copper-organic co-biocide systems. These formulations are somewhat more corrosive than CCA and this has required a tightening up of the recommendations on corrosion resistance of fasteners and connectors. Ongoing research at the University of British Columbia and the University of Toronto focuses on improving the stability of these formulations in the wood. Registered uses for ACQ and CA include: decks, garden fencing, landscaping, board walks, gazebos, play structures, picnic tables.

Borates, in the form of disodium octaborate tetrahydrate (DOT), have made something of a comeback in Canada recently but no data are available on usage. Borates were used for dip-diffusion treatment of lumber in the 1960s and 1970s for export to the UK where wood-boring beetles are a problem. This activity died off for a variety of reasons to do with both production and market changes. The resurrection of borates has been as a pressure or pressure-plus-diffusion treatment, again mainly intended for export markets, but this time for termite resistance. Borate-treated lumber has also found a market in Canada for repair of wood frame buildings with moisture leakage and decay problems. Unlike the situation in the USA where borates have taken over the sill-plate market from CCA, borates are only used on a relatively small scale in Canada.

**Table 1**  
**Treated Product and Preservative use in Canada in 1999**

	Production Volume (M <sup>3</sup> ) in 1999			
Preservative	CCA	Creosote	Penta	Total
Lumber, timber & plywood	1,860,402	11,405	1,256	1,873,063
Posts	327,957	0	13,678	341,635
Poles and piling	162,316	27,037	127,744	317,097
Ties	0	166,677	0	166,677
Treating service only	766,982	1,474	842	769,298
Total	3,117,657	206,593	143,520	3,467,770

\* Source: Stephens et al (2001)

### **Treating Plants**

The number of treating plants in Canada has stayed around 65 for many years (Stephens *et al.* 1994, 2001), though old plants close, new ones open and ownerships keep changing. The distribution of treating plants mainly reflects Canada's population. Quebec has a few larger plants rather than many small ones. British Columbia has a larger than expected number of plants reflecting higher demand for treated wood in this province. About one sixth of the plants are focused on industrial wood products and the remainder are focused on the residential market. However, the level of specialization is decreasing.

The total treating-cylinder volume in Canada was estimated at 4,025 m<sup>3</sup> in 1999 (Stephens, *et al.* 2001) unchanged from 1992 (Stephens *et al.* 1994), but treating plants were only operating around 50% of theoretical capacity. Much of the production occurs in the winter and early spring, in preparation for the spring and summer boom in outdoor construction projects.

Within the consumer lumber sector, we can distinguish two types of treaters. Treating service only (TSO) and full service treatment (FST) plants. The TSO plant provides a service to the owners of lumber who may be wholesalers, brokers, retail yards or end users. The FST plant purchases lumber, treats it and re-sells it under its own brand. Treaters producing industrial products generally deal directly with the end user.

In 1992 treating plants producing consumer lumber distributed 60% of production to wholesalers, 20% to retail buying groups, 15% directly to retail outlets and minor amounts directly to homeowners and contractors (Stephens, *et al.* 1994). Wholesalers sent 60% of their product to retail buying groups and 30% to retail outlets with minor amounts to homeowners and contractors. The retail outlets sold 60% of their product to homeowners and 40% to contractors. This pattern of distribution is believed to be largely unchanged in 2005.

### **Wood Species**

Canada's forests primarily comprise the spruce-pine-fir (SPF) species group. In 1992 Spruce-pine-fir (SPF) at 39%, jack pine (*Pinus contorta*) at 23% and lodgepole pine (*Pinus banksiana*) at 15% (both pines included in the SPF mix) were the major species used for treated consumer lumber. Red pine (*Pinus resinosa*) at 11% and hem-fir (*Tsuga heterophylla* and *Abies amabilis*) at 8% were the other two species/groups with substantial representation. Red pine and hem fir are typically used for nominal 4 x 4 and 6 x 6 posts in Eastern and Western Canada respectively. Lodgepole pine and jack pine thinnings are typically used for farm fence posts with lesser amounts of spruce. The species used for utility poles have been primarily western red cedar and lodgepole pine in the west and red pine plus jack pine in the east. Plywood made from Douglas fir, hem-fir (AKA hem-bal) and SPF (Canadian Softwood Plywood) are all treated for various applications. Permanent wood foundation (PWF) plywood is primarily hem-fir. Some western red cedar (*Thuja plicata* Donn) shingles and shakes are treated as are some sidewall shingles made from eastern white cedar (*Thuja occidentalis* L.) in Eastern Canada. Western red cedar is used untreated for decking. Most Yellow cedar (*Chamaecyparis nootkatensis* D. Don Spach) is exported since it is highly prized for its decay and termite resistance, including resistance to Formosan subterranean termites. The sapwoods of the species in the SPF mix are not the easiest to pressure treat and the heartwoods of these species are non-durable and highly impermeable. The relative treatability of Canadian species is listed in a table posted on [www.durable-wood.com](http://www.durable-wood.com).

## Processes

The preservative treatment of wood in Canada can comprise a considerable sequence of processes including drying, incising, pre-staining, pressure treatment, accelerated fixation (for CCA), re-drying and quality control processes as applicable. Not all of these are always used.

Lumber for treatment may be kiln-dried or air-dried. While kiln drying to 19% maximum moisture content can sterilize the wood and develop checks that can then be treated, the moisture content may be too low for optimum preservative penetration. Product specifically intended for pressure treating should ideally be dried to around 25% moisture content.

Most treating plants have one or more incising machines, which put a series of slits into the surface of the wood using toothed rollers. This improves the penetration of preservative into the heartwood of our difficult-to-treat species. Modern incisors have close-spaced patterns and thin, sharp teeth providing an integral shell of preservative treated wood. Incising is mainly used for products intended for structural members. It is rarely used for decking or other appearance grade products made from spruce-pine-fir because incising kiln-dried wood can leave very visible marks. One exception is southwestern BC where green hem-fir is sharp-tooth incised with minimal impact on surface appearance. Incising technology has been comprehensively reviewed by Morris, Morrell and Ruddick (1994).

Pre-staining of lumber prior to pressure treatment has allowed the industry to provide a range of factory colours on its CCA-treated product, mainly in western Canada. Most common are browns, reminiscent of western red cedar, and grays that give a pre-weathered appearance. CCA-treated wood can also be painted or stained by the contractor or homeowner when dry and the chromium component enhances the performance of these surface finishes by protecting the wood against UV damage.

The full cell (Bethell) process and its variants are used for pressure treatment with CCA while the empty cell (Lowry) process is used for creosote and pentachlorophenol. The full cell process has typically consisted of half an hour initial vacuum, several hours under pressure and a 15-minute final vacuum. Some of the plants in Canada still use cyclic pressures of constant amplitude but decreasing frequency. Pressure is raised to 1035 kPa (150 psi), the wood is allowed to absorb

solution until the pressure drops to 860 kPa (125 psi), then pressure is raised again to 1035 kPa. The operator determines the rate of solution absorption by the time taken for the pressure drop and stops the treatment when the amount of solution expected to provide the required retention has been absorbed. The majority of plants now use control valves which, maintain a constant pressure, 1035 kPa or higher, and allow circulation of preservative. Computer control and monitoring of treating plants has increased dramatically and a great deal of data on solution flow and uptake is being processed. There may be opportunities to use these data to more precisely predict treatment results.

Around 10% of Canadian treating plants have accelerated fixation chambers for CCA but the introduction of this technology stalled with the changeover to ACQ and CA. Fixation chambers provide moist heat for several hours and are typically designed to match the throughput of the treating cylinder(s) charge for charge. Under ambient conditions, particularly during continental Canada's winter, outdoor fixation can take weeks or even months. Accelerated fixation allows product to be shipped within hours of treatment if necessary (Cooper *et al.* 1995).

Kiln drying after treatment is only required for permanent wood foundations (PWF) and lumber or plywood intended for repairing decay in buildings. Most treated product is shipped in the wet, but fixed, condition.

## **Production**

Canada is second only to the USA, and equal to the UK, in the volume of treated wood produced. Production is, however, only about one tenth that of the USA. The Canadian production of treated wood in 1999 was almost 3.5 million cubic metres. (Stephens *et al.* 2001).

Over half of treated wood production was lumber, timber and plywood with 1,873,063 m<sup>3</sup> (Table 1) plus unidentified amounts captured under Treating Service Only (TSO). Posts 341,635 appeared to be the second largest volume treated but this was probably because part of the poles and piles total came under the TSO total. Poles and piling were recorded at 316,097 m<sup>3</sup> with additional unidentified volumes captured under TSO. Industry analysts believe production has remained fairly stable since 1999 and is not expected to change dramatically in the foreseeable future.

## **Exports**

Canada treats roughly 13% of its domestic consumption of wood but only 4% of its total production because almost all of Canada's wood exports leave the country untreated (excluding anti-sapstain treatments). About 10% of the production of the treated wood industry is exported and this varies widely from year to year because the pole export market is a highly volatile sector dependent on a limited number of large orders, which may or may not be secured in any one year. Treated lumber for export is normally processed to meet the standards of the destination country. Where the destination country does not have its own standards, the material may be treated to CSA standards. In 2004, the USA accounted for 98% of total export value but China showed the largest increase between 2001 and 2004.

## **Organizations**

### **WPC**

Wood Preservation Canada, (formerly the Canadian Institute of Treated Wood) is dedicated to promoting and supporting a stronger Canadian wood treating industry, promoting the benefits to be gained from the use of quality treated wood products and preserving the integrity of the environment through responsible stewardship of our resources. It is made up of preservative manufacturers and treaters, with an associate membership for other interested individuals.

## CWPB

The Canadian Wood Preserver's Bureau is an independent organization consisting of consumer and industry representatives who have established regulations for the inspection of pressure treated wood in order to meet rigorous standards. Consumer representatives form the majority of the governing body. Participation in the CWPB Quality Assurance Program assures that licensed producers meet the minimum criteria of the CSA O80 series of standards.

## CWPCA

The Canadian Wood Preservation Certification Authority certifies treating plant compliance with the Recommendations for the Design and Operation of Preservation Facilities (see section on regulatory arena below). The program consists of annual internal self audits where a trained/certified representative from each facility will review the design and operating practices in accordance with the TRD protocols. Every third year each facility will be audited by an accredited third party auditing firm selected by CWPCA to ensure compliance in accordance with the TRD protocols.

## CWPA

The Canadian Wood Preservation Association provides a forum and a focal point for all people interested in the various facets of wood preservation. Membership consists of a wide cross section of individuals involved in chemical supply, wood treating, wood preservation research, lumber distribution, lumber retailing, supply of application equipment and use of wood products. The association aims to promote the advancement of knowledge, expertise and high standards of technology in wood preservation and related fields. It also publicizes the importance of wood preservation in the conservation of our natural resources. The CWPA holds an annual convention alternating between eastern and western Canada. The two-day conference invites Canadian and international speakers to present topical papers on wood preservation and related fields.

## CSA

The Canadian Standards Association is a not-for-profit independent private sector organization. It serves the public, governments and business as a forum for national consensus in the development of standards. The CSA Technical Committee on Wood Preservation oversees revisions to the O80 series of standards. It comprises representation from chemical manufacturers, treaters, government regulators, researchers, consultants, utilities, railroads and the general public. The committee sets up task forces to develop, review and revise parts of the standard. It does not have the resources to cover all aspects of standard development consequently CSA O80 series refers to a number of American Wood Preservers' Association standards for analytical standards and preservative specifications.

## **Codes and Standards**

### CSA O80 Series:

Canadian standards for wood preservation were originally based on the American Wood Preservers' Association commodity standards, modified for Canadian conditions. These standards focused on industrial products thus it has been necessary to develop new standards to deal with residential treated wood products. Conversion to a Use Category type standard is currently underway. Only preservatives registered by the Canadian Pest Management Regulatory Agency are listed. The recently published supplement to CSA O80 series 97 added ACQ and CA to the standards for a wide variety of uses.

Typical requirements for industrial treated lumber are that 80% of samples must be penetrated to 10mm or more. The required penetration and the assay zone for poles vary according to the wood species. Structural and ground contact residential treated wood products are covered under CSA O80.32, which is currently being revised and expanded. This will have penetration requirements of 5 or 8mm. Light duty above ground residential applications are covered by CSA O80.36, a process specification for small dimension and profiled wood products that cannot be incised without excessive damage. This includes deck boards and battens for rainscreen cavities. A major caveat is that these products must not be in direct contact with untreated wood, other than naturally durable woods. This is intended to preclude direct attack by fungus mycelium and restrict the potential threat to fungus spores. The lack of a penetration requirement in this standard is based on fundamental work in collaboration with the University of British Columbia showing that checks penetrating the treated zone are protected by mobile copper (Choi et al. 2004, Morris et al. 2004).

#### National Building Code of Canada:

The recently published 2005 edition of the National Building Code has more and clearer requirements for preservative treatment. Pressure treated wood must be used for wood elements in direct contact with the ground, framed into concrete below ground level, where moisture accumulation is anticipated, for retaining walls over 1.2m high or supporting foundations. Sill-plates are not required to be treated provided the vertical clearance to the finished ground level is more than 150mm or a damp-proof membrane is used to separate them from concrete. In termite areas, now defined, pressure treated wood is required unless the clearance to the ground is more than 450mm. The CSA O80 Series of standards are referenced.

#### International Standards

Canadians also play a major role in wood preservation standards development outside Canada (Morris 1994, 1995). Several Canadians have, for many years, been active contributors to the subcommittees and task forces of the American Wood Preservers' Association standards committees. Paul Morris was a member of the drafting committee of the China Industry Standards for Wood Preservatives and Use Category and Specification for Preservative Treated Wood. The secretariat of the new ISO TC 165 Subcommittee 1 Wood Materials, Durability and Preservation is maintained by Wood Preservation Canada and Paul Morris is the chairman of that subcommittee.

### **Regulatory Arena**

#### Statutory Re-evaluation of Registrations:

The re-evaluation of registrations for heavy-duty wood preservatives was announced in July of 1992 (McCullagh 1993). Manufacturers of wood preservatives were asked to provide updated scientific data on occupational exposure, human toxicology and environmental chemistry and toxicology. Based on a risk assessment and an analysis of the benefits of wood preservation, a number of approaches will be considered. For each preservative these may lead to maintenance of the status quo, revisions to label recommendations for personal/environmental protection, process requirements to reduce health and environmental risks or even withdrawal of the registration. Consultation with stakeholders would precede any action. When this process began there were three government departments involved, but these activities have now been consolidated under the Pest Management Regulatory Agency within Health Canada (McCullagh 1995). The re-evaluation is still in progress (Aucoin 2002) and no final results have been issued. Registrations of new preservatives are also in progress under a cost recovery scheme. PMRA and the US Environmental Protection Agency have supposedly harmonized registration requirements, thereby facilitating cross-border trade under the North American Free Trade Agreement but PMRA still requires more data than EPA.

#### Recommendations for Design and Operation of Treating Plants:

All but a few (slated to close down) of Canada's treating plants have recently been upgraded to meet the requirements of Environment Canada's Recommendations for the Design and Operation of Preservation Facilities (Environment Canada 1997). This document outlines all the available technologies and procedures for minimizing occupational exposure, health risks from the product and adverse environmental impact. Additional measures on new concrete pads and foundations include plastic liners, monitoring wells and flushing systems.

Considerable amounts of capital have been expended on pollution abatement in Canada. Typical projects include extending the paving of plant operating areas, epoxy coating of concrete surfaces, dedicated on-pad and off-pad forklifts, covered storage areas for freshly treated wood, enhanced kick-back and drip recovery systems, accelerated fixation chambers, and storage tanks for contaminated rainwater.

#### Best Management Practices for Aquatic Environments

The WPC (CITW) and the Western Wood Preservers Institute developed the Best Management Practices for the Use of Treated Wood in Aquatic Environments in response to concerns raised by the users of treated wood. Processes and procedures for minimizing migration or leaching of preservative into the environment are specified for all registered preservatives.

The recommendations include: ensure the wood entering the retort is free from residues that could absorb preservative and subsequently slough off, use a post-treatment expansion and steaming bath for creosote, minimize over-treatment, verify fixation for CCA, and inspect for surface deposits prior to shipment.

#### Strategic Options Process:

Environment Canada developed a list of potentially toxic chemicals in industrial use and assessed their hazard to the environment and developed options for reducing the risk of adverse environmental impact (Munson 1995). The wood preservation industry is a single sector using several of the chemicals on the list including arsenicals (incorporating chrome VI), polyaromatic hydrocarbons (from creosote), and dioxins (as contaminants of pentachlorophenol). The Toxic Substances Management Policy divides the types of options into Track 1 and Track 2. Track 1 means virtual elimination and is designed for toxic substances that are manufactured, persistent and bio-accumulative. Track 2 means cradle-to-grave management to minimize the risks by reducing human exposure to, and release to the environment of, other substances of concern. It appears that CCA, Creosote and Penta are all going Track 2. The goals for Track 2 are based on a balance of health, scientific, technical and socio-economic realities in a manner consistent with sustainable development. Since arsenic is a byproduct of the purification of metallic ores, and creosote is a byproduct of coke production, these are not considered to be deliberately manufactured. Pollution prevention is a key goal. Risk reduction measures rely heavily on the Recommendation Document for the Design and Operation of Preservation Facilities and the Best Management Practices for The Use of Treated Wood in Aquatic Environments. Current methods of disposal of treated wood at the end of its service life are considered to constitute a release of preservative to the environment. Further research into methods for recycling preservative-treated wood is therefore warranted. Currently between 50 and 100% of utility poles removed from service are re-used or recycled. Disposal of consumer lumber has not become a problem as yet. Landfill of treated wood is permitted, at landfill sites where untreated wood is allowed, but space and cost considerations may rule this option out in the future.

#### Treated Wood in the Context of Sustainable Development:

The harvesting and regeneration of forests is central to Canada's economy. With minor exceptions, forests in Canada are not being cleared for farming or urban development. Nor are they being harvested at an unsustainable level. Nevertheless, we have come to recognise that the Canadian

forest resource is finite and recent revisions to the annual allowable cut have reduced lumber production. To put things in perspective over the past few years on average, three times as much forest area has been destroyed by wildfires in Canada than was harvested. It is to be hoped that in future the role of wood preservation in conserving our forest resource will be more fully recognized. CITW uses the slogan “Treated Wood Saves Trees” and Stephens *et al.* (1994) have quantified this statement. They calculated that, by extending the life of wood products in conditions conducive to decay, wood preservation annually saves about 66 million trees in Canada.

## **Research**

The major wood preservation research groups in Canada are at the University of British Columbia with Prof J.N.R. Ruddick, the University of Toronto with Prof. P. Cooper, and Forintek Canada Corp. with Dr. P. Morris. Other groups working in this area are the Wood Science and Technology Centre of the University of New Brunswick, Powertech Labs, Quebec Hydro, and Bell Canada.

Canadian wood preservation research is known particularly for advancements in incising and CCA fixation, spurred on by our difficult-to-treat species and relatively cold climate. Other research products include new preservatives (such as ACQ developed by Domtar), process modifications, preservative recycling and environmental clean-up systems, new test methods and improvements in the understanding of factors affecting the performance of treated wood.

Performance data on Canadian treated wood products is developed primarily by Forintek Canada Corp and published in a series of papers in the proceedings of the Canadian Wood Preservation Association (Morris 2000). Key data are also posted on [www.durable-wood.com](http://www.durable-wood.com).

## **Prospects for the Future**

We anticipate increased use of borates to produce termite-resistant framing for export markets where the use of wood is currently limited by termite problems. These markets include the US south, the Caribbean and Southeast Asia. Exporting treated wood helps to reduce the seasonality of Canadian treated wood production. New process technology is being introduced that will allow deep penetration of borates without the use of pressure treatment (Ross 2006, Morris and Minchin 2006).

In the short to medium term we can expect the introduction of metal-free preservative systems for above ground applications, but these may have to be three-component systems or use adjuvants to prevent biodegradation of individual components. These will also require additional co-formulants to provide UV resistance and water repellency. Improved transparent coatings will be introduced to reduce the requirements for maintenance of wood outdoors while retaining its natural appearance.

We may see changes in the proportions of wood species used by treaters in the near future with increased enforcement of standards. For example work at Forintek has shown Pacific Silver fir (*Abies amabilis* Dougl., Forbes) is Canada’s most treatable thin sapwood species (Morris 1995). It is the only Canadian species with which many Canadian standards can reliably be met by Canadian treaters. Several BC coast sawmills are looking at separating out this species from the hem-fir mix and making it available to the treating industry.

Wood plastic composite (WPC) decking is making inroads into markets for treated wood but these have not lived up to performance claims (Morris and Cooper 1998) and 40% of WPC production now contains biocides to prevent decay and disfiguring fungi (Manning 2006). Several methods of protecting wood by physical and chemical treatments, without biocides are being commercialized, however these typically have high energy or chemical costs and have not been shown to be

complete substitutes for preservative treated wood in terms of performance. For example thermal treatments don't improve the termite resistance of wood and gaining equivalent decay resistance to Western Red Cedar entails up to 50% loss in strength properties (Doi, et al. 2004; Smith et al. 2003).

Cradle-to-grave responsibility for wood preservatives will be put into practice and methods for recycling preservative treated wood will likely become commercially available early in the next millennium. At that point, treated wood will truly be considered alongside untreated wood as a fully renewable resource.

Anybody interested in more information on the progress of wood preservation in Canada should seek out the proceedings of the Canadian Wood Preservation Association and read the last few years worth of papers.

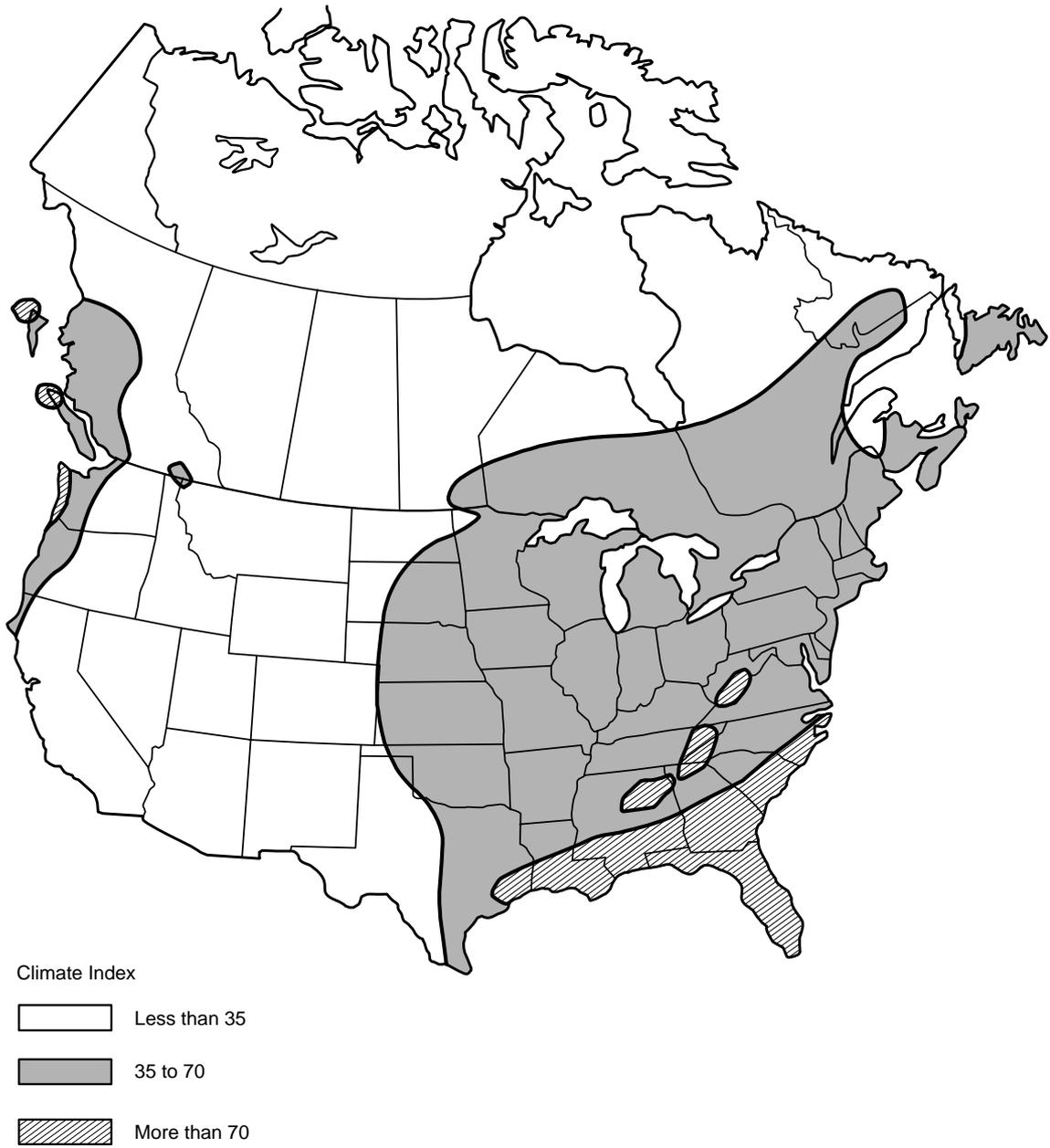
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**Figure 1.**  
**Decay hazard map for North America based on the Sheffer Index**



*(Sources: Scheffer, 1971; DeGroot & Esenther, 1982; Setliff, 1986)*