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WHITE PAPER

Lifespan Expectancy of WFX™ Polymeric Fire Retardant Treated Wood

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CONTENT

Addressing the Need for Lifespan Assessment of Fire-Retardant Treated Wood Cladding

Market demand is steadily increasing for reliable data on the expected service life of polymeric fire-retardant treated wood cladding. At present, however, no harmonized international standard exists for determining lifespan expectancy in terms of years.

To bridge this gap,
Woodsafe Research & Development has undertaken a qualitative study aimed at estimating the long-term durability and expected service life of its **WFX**™ fire-retardant treatment.

This document presents the key findings and core insights from that study, providing a foundational reference for stakeholders seeking evidence-based guidance on the longevity of fire-retardant treated wood in real-world applications.

Executive summary

This document outlines the key aspects of a qualitative study conducted by Woodsafe Research & Development to address the growing market need for reliable data on the expected lifespan of its product, **WFX**™. In the absence of a harmonized standard for verifying service life in terms of years, the study aims to provide an informed estimate of **WFX**'s durability and long-term performance.

> Fire-retardant treatments based on heat-cured polymeric systems are currently the only fire-retardant technologies approved for exterior wood applications.

> Long-term real-life testing demonstrates that fire-retardant treatments based on heat-cured polymeric systems exhibit high leach resistance (LR) and maintain their effectiveness under prolonged exterior environmental exposure.

> The in-situ retention of the heat-cured polymeric fire-retardant treatment is projected to exceed 30 years or longer, subject to site-specific variables including climatic exposure, latitude, wood species, and end-use application. Long-term performance may deviate based on these environmental and material-specific parameters.

Background and Methodology

It is widely acknowledged that fire-retardant treatments based on heat-cured polymeric systems outperform competing solutions in maintaining long-term fire performance (reaction-to-fire properties). Despite this, the industry continues to face a significant challenge: the absence of deterministic, standardized methods to quantitatively assess lifespan expectancy in years.

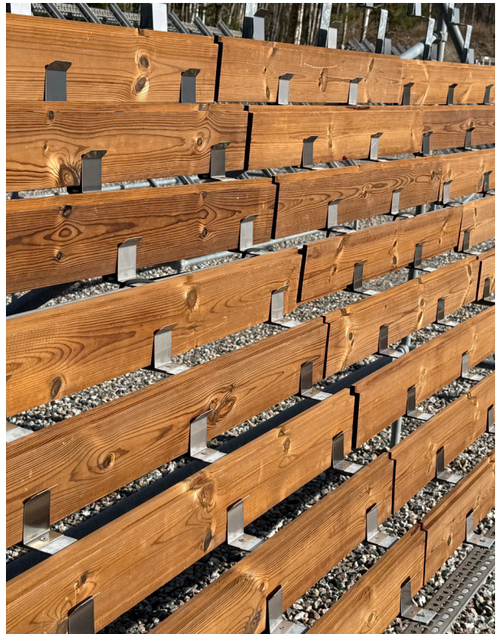
To help address this gap, Woodsafe Research & Development has conducted a qualitative study aimed at providing the market with a well-founded estimation of the expected service life of **WFX**™-treated wood.

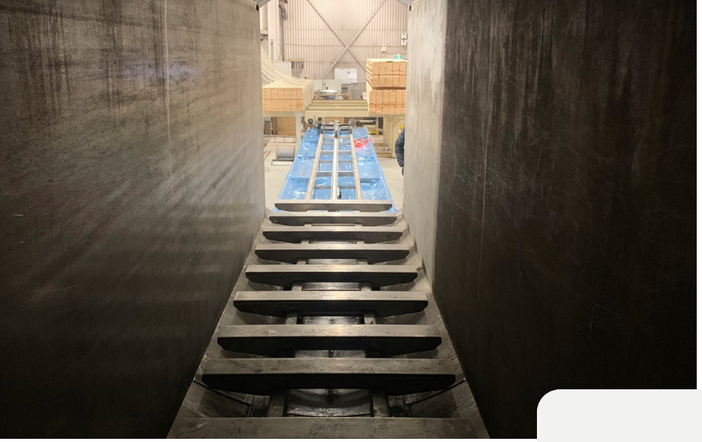
The study was based on three key methodologies:

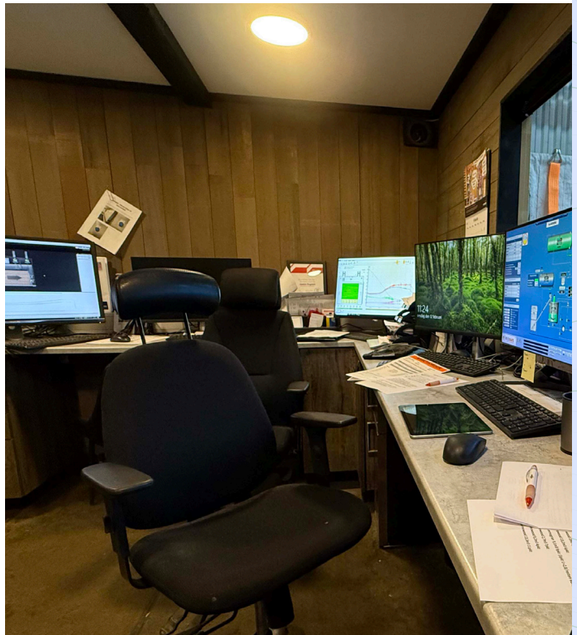
1. Long-Term Outdoor Weathering Experience
This approach integrates findings from published international long-term weathering studies, input from commercial stakeholders, and Woodsafe's own extensive field experience with WFX-treated wood in real-world applications.

2. Accelerated Weathering Testing
Testing was conducted in accordance with international standards such as ASTM D2898 and EN 16755. These test results are critical for validating the treatment's compliance and suitability for exterior use under various environmental conditions.

3. Comprehensive Literature Review
An in-depth review of scientific articles, commercial product data, and other relevant publications was carried out to gain a holistic understanding of the service life of polymeric fire-retardant treated wood.







Fundamental of the **WFX**™ Manufacturing Process

Understanding the **WFX**™ manufacturing process behind wood cladding treated with a polymeric resin fire-retardant is essential to recognizing its superiority over all known alternative solutions.

WFX™ utilizes an advanced heat-curing system based on a water-soluble organic polymer resin. The treatment is applied to the timber through a vacuum-pressure impregnation process, followed by high-temperature curing, which initiates polymerization.

During the curing process, the water-soluble fire-retardant chemicals undergo a chemical transformation. They establish permanent covalent bonds with the wood's natural constituents—lignin, hemicellulose, and cellulose—through a complex network of chemical interactions.

This molecular bonding mechanism is the key to the treatment's exceptional durability, as it forms a high molecular weight, water-insoluble resin matrix. This matrix not only integrates seamlessly with the wood structure but also enhances resistance to leaching and environmental degradation, ensuring long-lasting fire-retardant properties even under demanding environmental conditions.

Additionally, the non-hygroscopic nature of the treatment prevents moisture uptake, maintaining the integrity and performance of the fire-retardant over time.

Independent 10-year outdoor exposure of polymeric fire-retardant treated wood

The Forest Product Laboratory at the United Department of Agriculture Forest Service

Wood shingles and shakes are both aesthetically appealing and highly durable, making them a popular choice in commercial and residential construction. In certain jurisdictions, building codes require that these materials be treated with fire-retardant agents to meet fire safety regulations.

To support compliance and evaluate treatment effectiveness, the U.S. Forest Products Laboratory (FPL) conducted a comprehensive study aimed at assessing the performance and long-term durability of various fire-retardant treatments following outdoor weathering.

The study involved a 10-year weathering exposure, with samples installed facing south at a roof angle of 37.5°. The findings clearly demonstrated that shingles treated with a heat-cured polymeric fire-retardant outperformed all other treatment types. These samples exhibited a flame spread of only 29 inches after a full decade of exposure, and uniquely, they were the only specimens to self-extinguish during the Schlyter tunnel test.

Furthermore, the polymeric fire-retardant treatment displayed a high degree of leach resistance, significantly surpassing all alternative methods in long-term retention of fire performance.

To simulate real-world aging and evaluate long-term effectiveness under variable conditions, accelerated weathering tests are widely used. These tests are specifically designed to identify weaknesses such as leaching of active fire-retardant compounds (see Appendix I for a historical overview of globally recognized accelerated weathering methodologies).

Standardization and Literature Review

Accelerated weathering test methods such as ASTM D2898 (United States) and EN 16755 (European Union) have been incorporated into key international standards to assess the durability of fire-retardant treatments for exterior wood applications. Available test data—both publicly available and provided by manufacturers—consistently show a clear pattern: only wood treated with heat-cured polymeric flame retardants, as described in earlier sections, meets the stringent requirements for exterior cladding use. These treatments are the only ones that reliably withstand the rigorous testing protocols outlined in ASTM D2898 and EN 16755.

Findings from Literature Review

A substantial body of international research conducted over recent decades supports the superiority of polymeric flame-retardant systems in terms of durability and expected service life for fire-retardant treated wood. For example, Russell et al. state unequivocally that heat-cured polymeric systems are the only fire-retardant technologies currently approved for exterior applications. Although timber treated with these systems is not classified as "preservative-treated," it has been proven to outperform untreated wood in terms of overall durability.

This conclusion is further reinforced by the Wood Protection Association (WPA) in the United Kingdom. In its Specification: Service Environments and Treatment Types, the WPA outlines how the recommended treatment for unprotected exterior cladding (Type EXT) is achieved. According to the specification:
"Leach resistance is brought about by high-temperature curing of the complex chemical system in the treated wood following impregnation and re-drying."

WPA Type EXT treatment, aligned with EN 16755 requirements, is suitable for Service Class 3 applications as defined in EN 1995—the most demanding category for exterior wood use in terms of exposure to moisture and weathering.

Advanced Fire-Retardant treatment

WOOD**SAFE**® **WFX**™ for Long-Term Exterior use

WOOD**SAFE**® **WFX**™, is a advanced fire-retardant treatment based on a heat-cured polymeric resin system. It utilizes a water-soluble organic polymer that is impregnated into the timber under vacuum pressure. The timber then undergoes a high-temperature curing process, during which the chemicals are chemically transformed into a high molecular weight, water-insoluble resin that forms permanent covalent bonds within the wood matrix.

This process results in a permanent, non-hygroscopic, and leach-resistant (LR) fire-retardant treatment—specifically engineered for long-term performance in exterior environments.

The **WFX**™ treatment is exclusively carried out at Woodsafe's production facility in Sweden, an accredited service treatment center certified under ISO 9001:2015 (quality management) and ISO 14001:2015 (environmental management).

Independent third-party quality assurance is conducted by leading authorities, including:

- RISE Research Institutes of Sweden
- Wood Protection Association (WPA), United Kingdom
- Norwegian Institute of Wood Technology (Norsk Treteknisk Institutt), Norway

Drawing on decades of experience and supported by global research and regulatory standards, Woodsafe confidently maintains that heat-cured polymeric resin systems are the only fire-retardant treatments currently approved for exterior wood applications.

As such, we affirm the long-lasting, reliable performance of **WFX**™ in the most demanding outdoor environments.

Benchmark APPROVED TREATER WPA
Certificate no: FR-201901

WOOD**SAFE**® **WFX**™ has certified properties issued by a third-party accredited organization (RISE, No. 0402) in accordance with the EN 16755 standard, which pertains to the durability of fire performance (TG0263-08)

The certification of the WFX fire retardant has been conducted without surface treatment as follows:

- Hygroskopic properties EN16755 INT2, sapwood pine
- Classificationreport before ageing EN13501-1
- Aging i climatchamber EN16755 EXT
- Method B
- UV light
- Single Burning Item (SBI) test after aging and compared with classificationsreport before aging EN13501-1

Woodsafe typeapproval (TG 0263-08) covers all wood species according to EN 16755 EXT.

International acknowledgement

The flame-retardant manual from Wood Protection Association (WPA) in the UK classifies WOOD**SAFE**® **WFX**™ as a Leach Resistant (Type EXT) product which means that treated wood and board products can be used in all interior and exterior applications with no requirement to apply top coating such as paints. All wood species are included in the approval.

US approvals and supporting data

It all started in the US with the need of fireproofing cedar shingles and shakes. Since the first approval by Underwriters Laboratory, the use of polymeric resion treated timber (similar with **WFX**™)continues to be reviewed and re-approved as Class A material.

The original flame retardant has passed the US building most stringent codes of fire retardant tests and have passed the Uniform Building Code Standard 10 years natural weathering test based on the Underwriters Laboratory UL-790. This requires roof test decks to be flame tested after 1, 2-, 3-, 5- and 10-years natural weathering.

To qualify as a Class A material, the US model building codes require a flame spread rating of 25 or less and a smoke developed rating of 450 or less, when the standard surface burning test after accelerated weathering is extended to 30 minutes.

Test extended to 30 minutes and after completion of ASTM D2898. (Original method to EN 16755)

Solid Timber	*Flame Spread	*Smoke Development
Soutern pine	15	20
Douglas Fir	15	0
Western Red Cedar	20	45
Spruce	2	0

Estimated Lifespan and Proven Performance of Woodsafe's Polymeric Resin Fire-Retardant Treatment

Based on international 10-year outdoor weathering studies, compliance with European Union standards incorporating accelerated weathering methods, extensive experience from a wide range of international projects, and a comprehensive review of the scientific literature, Woodsafe Research & Development estimates that the lifespan of its heat-cured polymeric resin fire-retardant treatment is theoretically assessed to exceed 30 years or longer, subject to site-specific variables including climatic exposure, latitude, wood species, and end-use application. Long-term performance may deviate based on these. This estimate may vary based on variables and factors such as geographical location, latitude, wood species, and the specific application of the treated wood.

TG 0263-08

Our assessment is further substantiated by over 50 years of experience in manufacturing and globally distributing the heat-curing polymeric resin system.
To date, more than 10 million cubic meters of treated wood have been used in North America alone. The treatment's durability and performance are validated by approved test results from multiple international standards, including:

- EN 16755
- EN 13823 (Classification according to EN13501-1)
- ISO 5660-1
- ASTM D2898
- ASTM E84 (commonly known as the Steiner tunnel test)
- ASTM E108-20a
- ASTM E1354

These certifications and test results underscore the proven reliability and long-term efficacy of Woodsafe's fire-retardant treatment across a wide variety of applications and environmental conditions.

APPENDIX I: HISTORICAL BACKGROUND OF ACCELERATED WEATHERING TESTS

Historical Context and Evolution of EN 16755

The origins of the EN 16755 standard can be traced back to the United States in the 1970s, where the world's largest market for fire-retardant treated wood was emerging. At the center of this development was ASTM International—originally known as the American Society for Testing and Materials—an independent, non-profit standardization organization founded in 1898 and now comprising members from over 120 countries.

A cornerstone in this evolution is ASTM D2898, a standard that defines recognized methods for evaluating the natural or accelerated weathering of fire-retardant treated wood. The methods were specifically developed for wood products treated via vacuum pressure impregnation, rather than surface-applied coatings, thereby enabling deeper and more durable protection.

ASTM D2898 was first approved in 1970, introducing Method A and Method B, both of which remain highly influential today. These methods form the scientific and technical foundation of the European standard EN 16755, which was later developed to address the growing need for reliable durability classifica

tion of fire-retardant treatments in wood exposed to exterior conditions.

The development of ASTM D2898 was significantly influenced by research initiatives from the U.S. Forest Service's Forest Products Laboratory, particularly in response to the increasing demand for fire protection in cedar roofing materials in the 1960s.

In addition to shaping EN 16755, Methods A and B from ASTM D2898 also serve as the basis for the Nordtest Method NT Fire 053, which focuses on the accelerated aging of fire-retardant treated wood products in Nordic conditions.

Method A simulates exposure to rain and is widely used in standards such as UL 790 and ASTM E108, primarily for evaluating the performance of fire-retardant roofing products like wood shingles and shakes. This method is generally the preferred approach for testing fire-retardant treated wood intended for exterior use.

Overview of ASTM D2898 – Method A and Method B

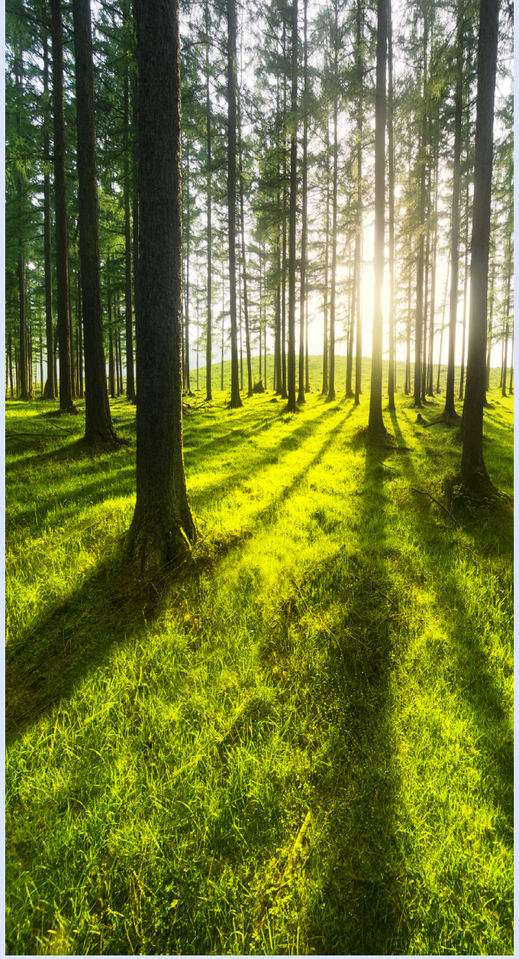
The ASTM D2898 standard outlines two primary methods—Method A and Method B—used to simulate accelerated weathering conditions for fire-retardant treated wood. Both methods have influenced modern standards, including EN 16755, and are widely referenced in evaluating long-term fire performance under exterior exposure.

Method A: Water Spray and Heat Exposure

- **Exposure type:** Water spray combined with elevated temperature
- **Duration:** 12 weeks
- **Purpose:** Simulates natural outdoor conditions, primarily rain and heat
- **Application:** Commonly used for assessing fire-retardant wood treatments intended for exterior use
- **Insight:** According to Holmes (1973), Method A yields comparable fire test results to Method B, regardless of whether the treatment is lacquer-resistant or not.

Method B: UV, High-Intensity Water Spray, and Heat Exposure

- **Exposure type:** Combines water spray, heat, and ultraviolet (UV) radiation
- **UV source:** Reflector-type sun lamps
- **Duration:** 6 weeks (half of Method A)
- **Development:** Originated from a test protocol used by the City of Los Angeles in 1964, later adapted by the U.S. Forest Products Laboratory (FPL)
- **Water spray intensity:** Flow rates approximately 40 times higher than in Method A, though total spray time amounts to just 29% of Method A's exposure
- **Purpose:** Accelerates aging processes to reveal weaknesses in fire-retardant systems, especially regarding UV sensitivity and leaching resistance



Both methods—despite differing exposure conditions—have been shown to produce similar fire test outcomes, reinforcing their validity for performance comparison of fire-retardant treatments. These findings also support the equivalency of ASTM D2898 and EN 16755 in evaluating long-term durability.

Source: U.S. Forest Products Laboratory – www.fpl.fs.fed.us

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