



**WOODSAFE® EXTERIOR WFX**  
Durable Fire Protection

— Let's talk —

**Lifespan expectancy of polymeric  
fire retardant treated wood cladding**



There is a growing demand on the market for addressing the lifespan expectancy of polymeric flame retardant treated wood cladding. Since there is no harmonized standard for verifying lifespan expectancy in number of years, Woodsafe has conducted a qualitative study in order to provide an estimation of the lifespan expectancy for **WOODSAFE** Exterior WFX. This document provides the main aspects of the study.

## EXECUTIVE SUMMARY

This document provides the main aspects of the qualitative study performed at Woodsafe in order to provide the market of a lifetime expectancy Woodsafe's product, Exterior WFX in the absence of a harmonized standard for verifying lifespan expectancy in number of years. The key findings are:

- Flame retardants based on heat-cured polymeric systems are the only flame retardants currently approved for exterior use.
- Long-time real-life tests shows that flame retardants based on heat-cured polymeric systems are Leach Resistance (LR) with long lasting properties in exterior environmental exposure
- Woodsafe makes the assessment that the polymeric heat cured Exterior WFX lifespan is estimated to be 30 years or longer depending on geographical location, latitude, wood type and application

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# Let's talk about how to evaluate lifespan expectancy

It is globally a well-known fact that flame retardants based on heat-cured polymeric systems outperform all other competing solutions when it comes to maintaining the fire protecting properties over time (Reaction to Fire properties). A challenge for the industry is that there exists no deterministic methods to quantitatively determine the lifespan expectancy.

Therefore, Woodsafe has conducted a qualitative study in order to provide the market with an estimation of the lifespan expectancy for Woodsafe Exterior WFX. The three main methods used in the study are:

1. **Experiences from long-time outdoor weathering.** This method is a combination from published international long-term studies, information from commercial actors and our own long-time field service experience with Exterior WFX treated wood.
2. **Tests based on accelerated weathering methods.** Results from tests according to international standards such as ASTM D2898 and EN16755 are crucial in determining compliance and allowance for outdoor use.
3. **Literature review.** Articles, web content and other written material such as commercial product information is central in finding a state-of-the-art knowledge regarding lifetime expectancy of polymeric flame retardant treated wood.

## LIFESPAN EXPECTANCY INDICATORS OF POLYMERIC FLAME RETARDANT TREATED WOOD CLADDING IN GENERAL

First of all, it is important to know the nature of the method used in manufacturing of a wood cladding treated with a polymeric flame retardant in order to understand why it is superior to all other known alternatives.

The method uses an advanced heat-curing polymeric system based on water soluble organic polymer system applied to the timber by vacuum pressure followed by a high temperature curing process which promotes polymerization.

This process chemically converts the water-soluble chemicals to permanent covalent bonds with the wood constituents (i.e., lignin, hemicellulose and cellulose), which ensures a long lifespan of the achieved flame retardant properties of the wood.





# Independent 10 years outdoor exposure of fire retardant treated wood

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

Wood shingles and shakes are esthetically desirable and durable, and they are being used in both commercial and residential construction in a variety of ways. Because building codes in some localities require wood shingles to be fire retardant treated, the Forest Products Laboratory (FPL) undertook a study both to examine the effectiveness of potential treatments and to evaluate the durability of these treatments after outdoor weathering.

This paper discusses the effectiveness of various treatments after 10 years of outdoor weathering. Samples were exposed towards the south with a roof angle of 37,5°. Results presented in the paper confirmed that the samples treated with polymeric fireretardant agent outperformed other methods. It had a flame spread of only 29 inches after 10 years and the treated specimens were the only samples which self-extinguished in the Schlyter tunnel test.

The report also concluded that the polymeric fireretardant agent treatment had a high degree of leach resistance and outclassed all the alternative treatments.

## Accelerated weathering tests

In order to simulate long-term real-life behaviour of the fire retardant treated wood, accelerated weathering tests are used. These are designed to, among other things, expose leaching behaviour problems of the fire retardant chemicals used (see Appendix I for a historical background of the most common accelerated weathering tests used globally).





These test methods have been incorporated into standards over the world, for example, the ASTM D2898 standard in the US and EN16755 in the European Union. Available test results, both in the public domain and from manufacturers, clearly shows the same pattern in the results: It is only wood that have been treated with the polymeric flame retardant as described above that are approved for exterior use in cladding, i.e. that survives the heavy test conditions in ASTM D2898 and EN16755.

## Literature review

Internationally there are several studies done over the last decades that clearly illustrate the supremacy of polymeric flame retardants when it comes to durability and lifespan expectancy for flame retardant treated wood.

Russel et al. states that the only flame retardants currently approved for exterior use, are those based on heat-cured polymeric systems.

Timber treated with these systems is not considered to be preservative treated, although it has been shown that this timber is more durable than if it were untreated.

Consequently, the Wood Protection Association (WPA) in the UK has acknowledged this fact in their Specification – Service Environment and Treatment Types, states how the WPA recommended treatment for unprotected exterior cladding, Type EXT, is obtained: “Leach resistance is brought about by high temperature curing of the complex chemical system in the treated wood following impregnation and re-drying”. WPA & EN16755 Type EXT is suitable for EN1995 Service Class 3 applications, the most severe category.

**Benchmark**  
APPROVED **TREATER**



## Let's talk

### about lifespan expectancy factors of **WOODSAFE** Exterior WFX in particular

**WOODSAFE** Exterior WFX, is a flame retardant agent based on advanced heat-curing polymeric system based on water soluble organic polymer system applied to timber by vacuum pressure following by a high temperature curing process which chemically converts the water-soluble chemicals to a permanently bonded high molecular weight water insoluble resin.

This results in permanent non hygroscopic flame protection with leach resistance properties (LR). WFX treatment is undertaken at the Woodsafe Timber Protection production facility in Sweden, which is an accredited service treatment centre according to ISO 9001:2015 and ISO 14001:2015.

Based on our best knowledge and available facts from global sources that the only flame retardants currently approved for exterior use are those based on heat-cured polymeric systems, we feel confident in the longlasting properties of the product.





## International acknowledgement

The flame retardant manual from Wood Protection Association (WPA) in the UK classifies Exterior 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 flameproofing cedar shingles and shakes. Since the first approval by Underwriters Laboratory, the use of WFX treated timber continues to be reviewed and re-approved as Class A material. The original flame retardant has passed the US building most stringent codes of flame 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 weathering.  
(origin method to EN16755)

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



# CONCLUSION

Based on international 10-year outdoor weathering studies, our own compliance with European Union standards that incorporate accelerated weathering methods, our own extensive experience in international Exterior WFX projects and an extensive literature review, Woodsafe makes the assessment that the polymeric heat cured Exterior WFX lifespan is estimated to be 30 years or longer depending on geographical location, latitude, wood type and application.

Our statement is also based on the experience of more than 50 years of manufacturing of the heat-curing polymeric system with distribution worldwide where more than 10 million cubic meters have been used in North America only and supporting approved test results according to ASTM D2898, EN16755, American Society for Testing and Materials (ASTM) test method E-84 (commonly known as the Steiner tunnel test), ASTM E108-20a, ASTM E1354, ISO 5660-1, EN13823 and EN927: 6.

Finally, as there is no harmonized standard for verifying lifespan expectancy in number of years, Woodsafe Timber Protection disclaims formal or legal responsibility for the lifespan expectance estimation given in this document.

## Let's tell about Woodsafe Timber Protection

The **WOODSAFE**® method is a refining process using vacuum pressure impregnation which is an accepted process for impregnating wood around the world. The process is regulated by a specially developed control program, where a specific amount of fire protection agent for the wood type and fire class in question are monitored.

The principle for refining the properties of the wood means that oxygen in the wood is removed through a vacuum. Fire retardants are then added under a constant vacuum which, once the autoclave is filled, reach pressures of up and ratios according to the specific wood

type and fire class.

Our production is ISO 9001 certified, our long-term sustainability environmental work is ISO 14001 certified, and our production is under surveillance and continuous manufacturing control by RISE (No.body 0402) in accordance with the requirements of CPR 305/2011, Annex ZA, AVCP system 1 and 8 chap. 22 and 23 of the Plan, and the Building Act (SFS 2010: 900) and 4 § 2 and 3 PBL and the National Board of Housing building regulations (BBR) 2:2, 5:231, 5:551, points 2, 3 and 4, 6:21.





## APPENDIX I: HISTORICAL BACKGROUND OF ACCELERATED WEATHERING TESTS

The background to EN16755 began in the United States in the 1970s. The world's largest market for fire-impregnated wood. ASTM International, originally the American Society for Testing and Materials, is a non-profit standardization organization founded in 1898, now with members from about 120 countries. ASTM International Standard D2898 contains recognized methods for natural or accelerated removal of wood treated with fire retardants.

The method is developed and intended for wood products treated with fire-retardant chemicals by vacuum pressure impregnation rather than surface coating. The ASTM D2898 standard was originally approved according to Method A and Method B as early as 1970 in the United States.

The EN16755 standard is based on ASTM D2898, which has more than 50 years of research funded by the U.S. Forest Service Forest Products Laboratory. In connection with the increased need to protect cedar fires in North America in the 1960s, ASTM D2898 was adopted. The two original methods in ASTM D2898 are also the basis for the Nordtest method NT Fire 053 on accelerated aging of fire protection treated wood products.

Method A is the rain test in the Underwriters Laboratories (UL 790) and ASTM (E 108) standards for testing roof coverings, such as fire-impregnated wood shavings, and the one generally specified for fire-impregnated wood for outdoor use.

The exposure in method A is limited to water spray and heat for a total duration of 12 weeks.

- Method A and method B gave similar fire test results for a lacquer-resistant treatment and a non-lacquer-resistant treatment (Holmes 1973) and which is equivalent to EN16755.

- Method B is associated with a climate chamber developed at U.S. Pat. Forest Service Forest Products Laboratory (FPL) and includes exposure to ultraviolet light (UV) in addition to water spray. The UV exposure is provided by reflector type sun lamps. The total duration of method B is 6 weeks (half the time of method A).

Method B exposure was an adaptation of a method specified by the City of Los Angeles in 1964 for a wood chip weather test. Water spray in method B has flow rates that are 40 times greater than those in method A, but the total duration of water spray is 29% of method A.

Source: <https://www.fpl.fs.fed.us>





## REFERENCES

- Atlas Material Testing Solutions, 2001. Atlas Weathering Testing Guidebook. Chicago, IL: Atlas Electric Devices Company; 112 p.
- Bescher R.H., Henry, W.T., Dreher, W.A., 1948. A study of permanence of commercial fire retardants. In: Proceedings of American Wood-Preservers' Association annual meeting; St. Paul, MN, 1948 April 27-29: 369-377.
- Crosby, D.G., Moilanen, K.W., 1974. Vapor-phase photodecomposition of aldrin and dieldrin. *Environmental Contamination and Toxicology*, Vol. 2, No. 1: 62-74.
- DeGroot, R., Nesenson, P., 1995. Performance of preservative-treated wood shingles and shakes. In: Science and technology: the basis for improved roofing. Proceedings of the 11th conference on roofing technology; 1995 September 21-22, Gaithersburg, MD. Rosemont, IL: National Roofing Contractors Association; 1995: 22-30.
- Deka, M., Humar, M., Rep, G., Kricej, B., Sentjurc, M., and Petric, M., 2008. Effects of UV light irradiation on colour stability of thermally modified, copper ethanamine treated and non-modified wood. EPR and DRIFT spectroscopic studies. *Wood Science and Technology*, 42: 5-20.
- Dryja, T.P., Kimball, G.P., Albert, D.M., 1980. Light stimulation of iris tyrosinase in vivo. *Investigative Ophthalmology & Visual Science*, Vol. 19, No. 5: 559-562.
- Gardner, R.E., 1965. The auxiliary properties of fire-retardant treated wood. *Forest Products Journal*, 15 (9): 365-368.
- Grisack, H., 1995. Memorandum on proposed accelerated weathering test for AC107. Faxed April 21, 1995.
- Harada, T., Matsunaga, H., Kataoka, Y., 2009. The effect of coating on the leachability and combustibility of fire-retardant impregnated wood after weathering test. In: Proceedings Fire and Materials 2009 conference; 2009 January 26-28, San Francisco, CA London, UK: Interscience Communications; 191-200.
- Holmes, C.A., 1971. Evaluation of fire-retardant treatments for wood shingles. Res. Pap. FPL 158, Madison, WI: USDA, Forest Service, Forest Products Laboratory; 29 p.
- Holmes, C.A., 1973. Correlation of ASTM exposure tests for evaluating durability of fire-retardant treatment of wood. Res. Pap. FPL 194, Madison, WI: USDA, Forest Service, Forest Products Laboratory; 11 p.
- Holmes, C.A., Knispel, R.O., 1981. Exterior weathering durability of some leach-resistant fire-retardant treatments for wood shingles: A 5-year report. Res. Pap. FPL 403, Madison, WI: USDA Forest Service, Forest Products Laboratory; 13 p.
- Juneja S.C., 1972. Stable and leach-resistant fire retardants for wood. *Forest Products Journal*, Vol. 22, No. 6: 17-23.
- Kataoka, Y., Kiguchi, M., Williams, R.S., Evans, P.D., 2007. Violet light causes photodegradation of wood beyond the zone affected by ultraviolet radiation. *Holzforschung*, Vol. 61: 23-27.
- Lebow, S., 1996. Leaching of wood preservative components and their mobility in the environment Summary of pertinent literature. Gen. Tech. Rep. FPL-GTR-93, Madison, WI: USDA, Forest Service, Forest Products Laboratory; 36 p.
- Lebow, S.T., Williams, R.S., Lebow, P.K., 2003. Effect of simulated rainfall and weathering on release of preservative elements from CCA treated wood. *Environmental Science Technology*, Vol. 37, No. 18: 4077-4082.
- Lebow, S.T., Cooper, P., Lebow, P.K., 2004a. Variability in evaluating environmental impacts of treated wood. Res. Pap. FPL-RP-620, Madison, WI: USDA, Forest Service, Forest Products Laboratory; 10 p.
- Lebow, S.T., Foster, D.O., Lebow, P.K., 2004b. Rate of CCA leaching from commercially treated decking. *Forest Products Journal*, Vol. 54, No. 2: 81-88.
- LeVan, S.L., Holmes, C.A., 1986. Effectiveness of fire-retardant treatments for shingles after 10 years of outdoor weathering. Res. Pap. FPL-474, Madison, WI: USDA, Forest Service, Forest Products Laboratory; 15 p.
- Östman, B., Voss, A., Hughes, A., Hovde P.J., Grexa, O., 2001. Durability of fire retardant treated wood products at humid and exterior conditions-Review of literature. *Fire and Materials* Vol. 25, No. 3: 95-104.
- Östman, B., Tsantaridis, L., 2004. Durability and new service classes for FRT wood in different end uses. In: Proceedings Flame Retardants 2004 conference; 2004 January 27-28, London, UK: 139-150.
- Östman, B., Tsantaridis, L., 2007. Durability of the reaction to fire performance of FRT wood products in interior and exterior applications. In: Proceedings Interflam 2007 conference; 2007 September 3-5, London, UK. London: Interscience Communications: 33-44.
- Russell, L.J., Marney, D.C.O., Humphrey, D.G., Hunt, A.C., Dowling, V.P. and Cookson, L.J., 2004. Combining fire retardant and preservative systems for timber products in exposed applications – state of the art review, Forest and Wood Products Research and Development Corporation
- Shunk, B.H., 1972. Development of an all-weather fire-retardant treatment. *Forest Products Journal*, Vol. 22, No. 2: 12-15.
- Stark, N.M., 2006. Effect of weathering cycle and manufacturing method on performance of wood flour and high-density polyethylene composites. *Journal of Applied Polymer Science*, Vol. 100: 3131-3140.
- Sweet, M.S., LeVan, S.L., White, R.H., Tran, H.C., DeGroot, R., 1996. Fire performance of wood treated with combined fire-retardant and preservative systems. Res. Pap. FPL-RP-545, Madison, WI: USDA, Forest Service, Forest Products Laboratory; 10 p.
- Thorson, M., 1993. Memorandum from Michael Thorson to K. Scoot and R. Sherwin on subject of Department of Agriculture IR lamps. Dated June 30, 1993. Atlas Reference #93-18182MT.
- Williams, R.S., 2005, Chapter 7. Weathering of wood. In: Rowell, R.M. (ed.) *Handbook of Wood Chemistry and Wood Composites*, New York: CRC Press, pp. 139-185.







## Let's take some notes

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