Evaluation of decay resistance of wood fibre insulation based on hygrothermal simulation and comparative laboratory tests

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Abstract

To reduce CO₂ emissions and save grey energy, natural materials like wood and wooden materials are becoming more and more important. However, these products are particularly sensitive to moisture, as they can rot or be attacked by decay fungi. In the past years, new and detailed knowledge on the decay process of wood was gained. This knowledge allows the definition of more sophisticated limit conditions depending on coinciding heat and moisture and their duration, which can replace simple steady state limits like the widely used 20 % by mass. For wooden materials and natural fibre insulations, in most regulations the moisture limits are even lower - although there are certainly materials that are more resistant than solid wood itself. Therefore, within a project dealing with wood fibre as interior insulation, which is exposed to increased moisture levels during the winter months, the durability of such materials against decay is compared at different critical temperature and humidity conditions to the one of solid wood. Based on these results, the more resistant wood fibre materials can be evaluated like solid wood. Thus, their performance can be predicted more accurately by hygrothermal simulations and their application fields accordingly be extended.

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Keywords: wood fibre insulation, decay, rot, hygrothermal simulation, transient hygrothermal limit conditions

1. Introduction/Background

To reduce CO₂ emissions and save grey energy, natural materials like wood and wooden materials are becoming more and more important. However, as the products are particularly sensitive to moisture, they can rot or be attacked by decay fungi. Therefore it is often not clear in which applications they can be used or how the building assemblies must be adapted to ensure a safe performance of these materials. Hygrothermal simulations allow a reliable prediction of the temperature and moisture conditions, the materials are exposed to – not only for the whole material layer, but also for critical parts of it. High moisture levels occur mostly for short periods in winter time together with rather low temperatures in the exterior part or the constructions. Therefore it doesn't make sense to use conventional steady state limit values, like 18 or 20 % by mass, which ignore both, the coinciding temperatures and the duration of exposure. While for solid wood, temperature and humidity dependent limit values [1] [2] [3] [4] [5] and even transient evaluation models [6] are already available, such limit values and models are still missing for wood and natural fibre insulation materials.

2. Laboratory tests to compare the durability of wood fibre insulation against decay fungi to the one of solid wood

In the laboratory different types of wood fibre insulations, suitable for use as interior insulation at higher humidity levels, are investigated concerning their resistivity against decay fungi and compared with the one of solid wood. Therefore, test specimens of 50x50 mm are used with a thickness of 40 mm for the fibre insulation and 10 mm for the solid pine sapwood samples.

The specimens are inoculated with four different decay fungi which are either commonly used for decay tests in the standards or under suspicion to have a high affinity for wood fiber materials. The fungi types are *Serpula lacrymans*, *Coniophora puteana*, *Trametes versicolor* and *Schizophyllum commune*. The inoculation takes place through contact with already infested soft wood "dowels", but without contact to additional nutrients, which could accelerate the infestation and decay process. The test specimens are exposed to constant high RH values of 95, 97 and 100 % RH at 25 °C and thus to conditions which are well known to allow for decay processes [2] [3]. The tests last for 100 days and at the end, both, a visual assessment of the rotting progress as well as the mass loss measurement of the different insulation materials will be performed and compared to the behavior of pine sapwood, which is known as the most sensitive construction wood in Europe.

If the mass loss of a fibre insulation material remains lower than the one of the pine sapwood samples under all three test conditions and with all four fungi types, it can be assumed that the resistivity of the material is at least as high as for solid wood.

3. Definition of a simplified test

Based on an evaluation of the lab test procedure and results described in chapter 2, a simplified test method is developed, using only the most relevant decay fungi and temperature and RH conditions. Based on this test, in future a rather fast and cheap classification of wood fibre insulation materials as “equal or higher resistant against decay fungi than solid wood” will be possible.

4. Summary and conclusions

Due to their production process, wood fibre insulations can be rather resistant against decay fungi. Therefore, it is not helpful to use conservative steady state limits to evaluate their performance in internally insulated walls. In that case, most solutions will not meet the evaluation criteria, while they may perform well in practice. The lab tests described in chapter 2, allow to identify wood fibre insulation materials, which are equal or even more resistant to decay fungi than solid wood. Consequently, the available temperature and moisture dependent limit curves for example from [5] or even the transient decay prediction model from [6], which are both limited to solid wood up to now, can be also used for such resistant fibre insulation materials. If these limits are applied on the results of hygrothermal simulations according to EN 15026 [7] or ASHRAE standard 160 [8], a reliable prediction and evaluation concerning the use of wood fibre as interior insulation becomes possible. In addition a simplified test procedure is established, which allows for a fast and cost effective classification of specific insulation materials in future.

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