Fungal growth on timber frame houses

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1 EXPERIMENTAL RESEARCH ON FUNGAL GROWTH

Due to the increasingly stringent energy efficiency requirements, timber frame houses are becoming more and more popular across Europe. Since wood is an organic material, susceptible to mould growth and wood rot, an effective moisture control strategy is required to keep the moisture levels inside the building components to an acceptable level. Moisture related problems may affect the health of the inhabitants, or even jeopardize the building's structural integrity. To determine the acceptable moisture level inside a construction, a clear view on the development of fungal growth is essential.

Therefore, tests have been described in literature examining the critical moisture contents for decay. In a so-called pile test, executed by different researchers (a. o. Brischke & Meyer-Veltrup 2015; Stienen et al. 2014), a moisture gradient within a pile of small wood samples is created. After inoculation and an incubation period of 3-4 months, the relationship between moisture content and fungal growth is assessed. Main disadvantage of this test, however, is that moisture content and fungal attack is only evaluated at the end of the experiment, while fungal growth is a dynamic process. Furthermore, since this test includes a malt agar medium, results only apply in case a moisture and nutrition source is nearby, and RH is high.
Consequently, different researchers conducted experimental research without an external moisture and nutrition source (Brischke et al. 2017; Saito et al. 2012; Viitanen 1997). These tests amount to inoculate small wood samples with fungal mycelium or feeder blocks (= previously infested wooden specimens). The samples were then incubated at different levels of RH. These tests concluded that, without an external moisture source, progress of fungal growth can only occur at very high levels of relative humidity. However, the tests also resulted in contradictory findings whether progress of fungal growth can occur below fibre saturation point (FSP; point when there is a maximum of hygroscopic bound water in the wood cell walls, but no free liquid water in the cell lumen).
All laboratory experiments described above take advantage of sterile conditions and bring only the wood-degrading test fungus into the set-up by inoculation. In reality, however, fungal spores first need to colonize the wooden substrate. A significant time lag may occur between **onset**

and **progress** of fungal growth. Moreover, higher moisture levels may be required for the onset compared to the progress of fungal growth. The FSP might be a critical level in this regard. Furthermore, next to the exposure conditions, also design details may influence the service life of a timber construction. Hence, next to experiments without inoculation, experiments based on realistic conditions occurring during the specific end use of a timber product should be performed as well. So-called field tests are described in several European standards (a.o. CEN 2014). However, in these tests, wood samples are exposed to Use Class (UC) 3-4 (CEN 2013), whereas wood inside a timber frame construction is typically exposed to UC 1-3 conditions, which are less extreme. Tests examining the onset of fungal growth and the risk of fungal attack for a timber frame construction exposed to UC 1-3 are still lacking.

The present study aims at a contribution to the understanding of the influence of wood moisture content on the onset and progress of fungal growth. Based on the information that is still lacking in international literature, different specific experiments are executed at Woodlab-UGent and the Building Physics Section of KU Leuven. In a first experiment, the goal is to study the relation between moisture content and **progress** of fungal growth throughout the degradation process and in different climatic conditions, when an external moisture source is nearby. In a second experiment, the determination of the minimal moisture threshold and required exposure time for the **onset** of fungal growth is envisaged. In a last experiment, the risk of fungal growth in a timber frame wall exposed to UC 1-3 is studied.

2 CONCLUSION

The first results from the experiments conducted in this work show that, as long as no liquid water source is available, timber will only suffer from mould growth. The reliability of current mould growth prediction models depends on the considered wood species. Further, with the current set-up, progress of decay below FSP was not observed. Nevertheless, the relative humidity of the surrounding air clearly had an impact on the process. Further tests with an adjusted set-up should be conducted to further study the relation between moisture content and progress of fungal growth.

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