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Assessment of durability of environmentally friendly wood-based panels

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Abstract

The aim of this work was to evaluate the durability of selected wood-based panels according to the modified standard method D3273. Temporary wetting or storing in unfavourable conditions in different building stages initiates the growth of mould on the surface of wood-based panels due to the contamination of panels in early stages like manufacturing or transporting. The panels were tested as-they-were – no initial sterilization or particular test microorganisms were used. The tested panels showed notable growth of different types of moulds. The main mould occurred from the *Genus Aspergillus* what is considered as xerophilic. Under the optical microscope the network of fungal mycelium was detected also on panels what did not show visible growth. Environmentally friendly wood-based panels are very susceptible to the surface mould development whenever the favourable moisture conditions appear. The RH for the development of xerophilic moulds is relatively low — about 75% RH, what is rather common condition in the construction site. Surface mould, even it is not visible or actively growing, is potentially harmful to habitants. The results of this work were highly valuable to both scientists and structural engineers.

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Keywords: Environmentally friendly wood-based panels; surface contamination; mould growth; testing ;

1. Introduction

Wood, due to its many beneficial properties, is considered as a valuable consumable and construction material. Besides solid wood, new types of wood composites have been developed; among those environmentally friendly ones are gaining interest. The term “environmentally friendly” here is used for the wood composites where the “other” ingredients (mainly polymeric) are considered to have low negative impact to human health and environment, or

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panels what are manufactured solely from wood. In applications, one should distinguish between these types of panels. In houses, built according to a new construction concept called "Passive House", these materials are the most suitable and desired.

Newly built house may hide a myriad of problems originated from the quality of construction technology, materials suitability, or non-defined reasons. Building occupants may suffer from "Sick Building Syndrome" - the term what was coined by the WHO in 1986 [1]. The causes of which are probably multifactorial and it can be detected only after step-by-step elimination all other building related illnesses [2]. In many cases the real cause of the discomfort mains unsettled [3].

The problem with the materials elevated moisture starts from the contact of the surface with the source of moisture. This can be a direct contact with the water source or the contact with moist air. The main difference in these cases is only duration of contact. The equilibrium moisture content of the material accumulates over certain time causing delayed moisture damage. The surface of the materials exposed to high relative humidity of air is the main source of the moisture problems.

Optimally the humidity conditions for growth of practically all indoor fungi species are in a RH-range of 90–100%, but it is agreed by scientists that the most of indoor fungi species start a growth above 80% of RH occurring close to the surface [4]. Authors [5] divided moulds into categories according to minimal needs for the germination. Six groups were detected – highly xerophilic, xerophilic, moderately xerophilic, moderately hydrophilic, hydrophilic and highly hydrophilic. Highly xerophilic fungi needed for the start of the growth at 20 °C 75% RH what is less than commonly agreed. Additional to favourite environmental conditions the presence of food – some organic material - is necessary. Due to the fact that many mould species produce cellulolytic enzymes [6] leads to the results that wood-based construction materials are very good substrates for the mould growth without any additional actively encouraging additives.

For the development of the mould growth it is essential that mould spores land up to the surface. Potentially there is always some mould spores present what get onto the surface from the surrounding air. After manufacturing the construction material gets into contact with various indoor and outdoor environments and gains some mould onto the surface. Arriving to the construction site too early before the installation or installed into contact with other moist materials the mould growth suddenly proliferates.

Testing the potential of construction materials for the surface mould development is usually performed by following standard procedures:

- D 3274 Evaluating Degree of Surface Disfigurement of Paint Films by Microbial (Fungal or Algal) Growth or Soil and Dirt Accumulation
- D4610 Determining the Presence of and Removing Microbial (Fungal or Algal) Growth on Paint and Related Coatings
- D 5588 Determination of the Microbial Condition of Paint, Paint Raw Materials and Plant Areas

It is evident that existing standards and laboratory procedures are mainly targeted to the quality evaluation of finishing materials as the first priority of manufacturers. They are useful for validation of the critical moisture conditions for mould growth on building materials [7, 8, 9]. In 2012 a new edition of procedure to the first standard was issued D3273-12, but the main principle of the testing remained the same. In this laboratory procedure sterilized, oven-dried samples were sealed into the test chamber where the moist soil incubated with three different species of mould was placed onto the bottom. The temperature and air RH were controlled by loggers. The results were evaluated by visual inspection of developed surface mould in scale of 0-10 where the score 10 meant that mould growth was not visible. The test lasted 4 week during what regular evaluation was performed microscopically to discover early stages of mould development. This test is usually exploited for the testing of indoor coating materials like paints and varnishes. This standard procedure holds numerous shortages:

- Laboratory conditions where D3273 is applied are miles away from the real conditions at construction sites. The main shortage is the selection of three particular mould species
- In real situation, the surface of wooden construction materials is deteriorated by numerous moulds of random origin already before it arrives to the construction site
- This standard was developed in USA and singled out mould species might not be specific to other regions