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Conditions for mould growth on typical interior surfaces

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Abstract

Prediction of the risk for mould growth is an important parameter for the analysis and design of the hygrothermal performance of building constructions. However, in practice the mould growth does not always follow the predicted behavior described by the mould growth models. This is often explained by uncertainty in the real conditions of exposure. In this study, laboratory experiments were designed to determine mould growth at controlled transient climate compared to growth at constant climate. The experiment included three building materials with four different surface treatments. The samples were inoculated with 8 common indoor moulds. Even after 40 weeks no growth was observed on any sample. The paper describes different hypotheses for the missing growth, and how these have been tested.

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Keywords: Constant climate; fungicides; germination of spores; mode of inoculation; mould growthtransient climate; nutrients; water damage

1. Introduction

Prediction of the service life of building constructions is of great interest to designers and building owners. Models for service life have been developed – including models for prediction of the risk for mould growth – based on excessive laboratory studies as well as on practical experience. Some of these models are formulated as mathematical models suitable for post-processing simulated conditions in building structures, while others are factorial methods. [1, 2, 3, 4]

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1.1. Testing building materials for mould growth

Testing of building materials for mould growth has been of interest for many years [1,2,5]. One of the common ways to describe the susceptibility of a substrate – e.g. building material – to mould growth is an isopleth (see Fig 1). An isopleth describes the germination time and the growth rate of specific fungi for given constant temperature and water activity conditions. Water activity is in this paper referred to as relative humidity (RH). Isopleths exist for a range of materials and material classes.

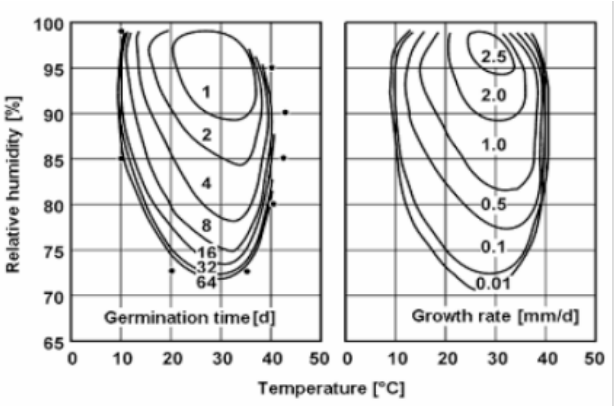

Fig. 1. Example on isopleths. Germination time (left) and growth rate (right) as a function of both temperature and relative humidity. From [1]

Most of the existing work where mould growth processes have been studied on building materials has been conducted on small specimens, and often under constant climatic conditions. Furthermore, the susceptibility to mould growth has been studied mostly on "raw" building materials such as wood, stone wool, gypsum board etc. without surface treatment. Typical materials of interest in the studies have been materials of organic origin like wood (typically pine and spruce) and building boards (e.g. gypsum board with cardboard facer, wood particle board, fiber board and plywood). The studies have focused mainly on testing mould growth at conditions for high water activity, i.e. 90% < RH < 100%, but also at lower RHs like 85% RH and even 75% RH. In some studies water was added directly on the samples, like in [6] where influence of different ways of wetting new and old gypsum board and other building materials on the growth of *Stachybotrys chartarum* was studied. A typical temperature range is 20 – 23 ºC, but some tests also exist for lower temperatures like 15ºC, 5-10ºC, and even temperatures below zero. A typical size of the small samples is around 5 x 5 cm². [6, 7, 8, 11]

A few studies have also included inorganic materials like different kinds of concrete and insulation materials [7, 9]. The role of organic matter on otherwise inorganic building materials was studied specifically in [9].

However, some experiments also exist with larger samples, which were exposed dynamic test conditions, both in respect to temperature and humidity, and even with combined materials. The variations are typically either cyclic with different lengths of periods or with natural variation of the outdoor climate [7]. An example of cyclic conditions with varying periods of both humidity and temperature is reported in [10]. Small samples of fiber board, gypsum board, spruce plywood, pine sapwood and cement screed were in this study exposed to temperature of 10ºC or 20 ºC and to relative humidity of 65% or 97% - or 90% or 100% in different cycles of 1 or 3 days.

Usually, fungal spores were inoculated on the sample surface by spraying the surface with a spore suspension. In many studies, the suspension was a mix of a number of typical indoor fungi [7, 8, 9, 10, 11]

1.2. Scope of the presented work

In order to add new knowledge to the understanding of the problem of mould growth on interior surfaces of building constructions, the study presented in this paper concentrates in proving some methodological issues: 1) Tested items were commonly used building materials in interior layers of exterior walls including final finishes such as paint or wall paper; this would be a new approach in respect to studying the sensitivity of real material combinations the way