

RAPPORT

Kontaktperson RISE	Datum	Beteckning	Sida
Gunilla Bok Samhällsbyggnad +46 10 516 57 78	2021-01-14	O100291-19192	1 (5)

Testing of critically moisture condition, SP Method 4927

Mission

RISE AB has on mission of JL Chemistry AB performed a testing respect wood samples treated with BIO-ECO TT40. The effect of the treatment with respect to the critical moisture state of the wood has been tested. The test was carried out according to SP Method 4927.

Definition

The resistance of different materials to microbiological growth (mold growth) varies. This variation depends on among Other on of the materials nutritional content, pH, surface structure with more. A way to describe a material or a treatment's resistance to microbiological growth. Mold growth is the relative humidity (RH) at which mold can begin to grow on the material or on a treatment.

This level called the critical the moisture condition (RF_{crit}).

RF_{chalk} is temperature dependent which means that at higher temperatures (more optimal temperature for molds) can fouling established at lower humidity levels which means to RF_{chalk} becomes lower.

Method

SP Method 4927 is a laboratory method for determining the critical moisture state of building materials. The method can apply on clean material as not has become exposed for environmental conditions that pose a risk of mold growth. The method can also be used to test the effect of material treatment, such as a chemical treatment.

The results from SP Method 4927 can not to be used for to evaluate how long a material can be exposed to different humidity conditions without mold growth occurring.

SP Method 4927 exists also as a technical description, SIS-TS 41:2014.

Method principle

A spore solution containing six various mold species as usually encountered on building materials are sprayed with specified concentration on the test pieces. The samples placed then in four different RH levels at 22 °C for twelve weeks.

Procedure

Seven test pieces measuring 50 x 100 mm are used for each RF level. In this test, seven untreated reference test pieces have been tested at the same time as treated material in each climate. A spore suspension is being prepared sterile and repeatable. The track suspension contains spores from the following fungi *Eurotium herbariorum* (CBS 115808), *Aspergillus versicolor* (CBS 117286), *Penicillium rubens* (CBS 401.92), *Aureobasidium pullulans* (CBS 101160), *Cladosporium*

RISE Research Institutes of Sweden AB

Postal address

Visiting address

Tel. / Fax / Email This

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Box 857
501 15 BORÅS

Brinell Street
4
504 62 Borås

010-516 50 00
033-13 55 02

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sphaerospermum (CBS 122.63) and *Stachybotrys chartarum* (CBS 109292). The concentration of the spore suspension is 10^6 spores/ml of each species. 0.4 ml is sprayed on each sample. All mushrooms has purchased from CBS-KNAW Collections that Westerdijk Fungal Bio Diversity Institute in Utrecht, Netherlands.

Incubation in climate chamber

The test pieces lie horizontally on a grid in the climate chamber with the sprayed side up for twelve weeks (95 and 85% for thirteen weeks). Four climate chambers have been used (CTS C-20/350, CTS GmbH, Hechningen, Germany). The climate in the various the chambers is sat to 80%, 85%, 90% and 95% RH. The temperature is 22 °C. Temperature and RH are continuously logged using the climate cabinets' integrated and calibrated sensors and saved using software (CID-pro).

Analysis of the growth

Every other week during probationary period taken the samples out from climate cabinets and analyzed in 40 times magnification. Microbiological growth is graded according to a five-point scale described in Table 1.

Table 1. Scale on assessment of growth

Assessment	Description of mold growth detected	Illustration ¹
0	No fouling	
1	Initial fouling; a or get hyphae are present on the surface, no conidiophores	
2	Economical but clearly established fouling. Conidiophores may occur.	
3	Spotwise close fouling with conidiophores.	
4	Close fouling on, in principle the entire surface.	

1. The pictures is a schematic illustration of the growth. Growth is not always visible to the naked eye.

Assessment of RF_{chalk} at Other temperatures

RF_{chalk} is determined by the lowest RH level at which fouling has been assessed to correspond to degree two or higher on at least two of the seven samples. The critical moisture condition is then assessed to be somewhere between the RF where fouling found and underlying RF level, according to equation 1.

$$RF_{low} < RF_{chalk} \leq RF_{higher} \quad \text{Equation 1}$$

Based on the RF level at which fouling occurs, a product or treatment is classified into one of f

ive material classes. according to table 2. Note to these material classes not is described in the test method.

Table 1. Description of the various the material classes.

Class	RF _{k_rite} 22°C
Class A	$75\% \leq \text{RF}_{\text{crit}} \leq 80\%$
Class B	$80\% < \text{RF}_{\text{crit}} \leq 85\%$
Class C	$85\% < \text{RF}_{\text{crit}} \leq 90\%$
Class D	$90\% < \text{RF}_{\text{crit}} \leq 95\%$
Class E	$95\% < \text{RF}_{\text{crit}}$

RF_{chalk} is validated at 22 °C. For to assess RF_{chalk} at Other temperatures can equation 2 be used.

$$\text{RF}_{\text{crit}(T)} = 105 + c(T^2 - 54 \cdot T) \quad \text{Equation 2}$$

Where T is temperature in °C and c is the value obtained in Table 3. Critical moisture state is calculated for the lower and higher the value in in equation 2. RF_{chalk} can Never be higher than 100% which means that the final RF_{crit} calculated in equation 2 can be expressed in equation 3.

$$\text{RF}_{\text{k_rite}} = \min(100, \text{RF}_{\text{crit}(T)}) \quad \text{Equation 3}$$

If the calculations is done in various temperatures (0-30 °C) can the critical humidity level described as curves in a diagram.

Table 2. c-values from equation for each class with lower and upper values.

Class	RF _{low}	RF _{high}
Class A	0.043	0.036
Class B	0.036	0.028
Class C	0.028	0.021
Class D	0.021	0.014
Class E	0.014	-

Results

No deviation with respect on spore solution purity and vitality was found. Analysis results after twelve weeks are reported in Table 4. Rf_{crit.} for untreated wood is

$75\% \leq \text{RF}_{\text{chalk}} \leq 80\%$. For treated samples is the critical the moisture condition $90\% < \text{RF}_{\text{chalk}} \leq 95\%$.

Untreated wood samples corresponds to a critically moisture condition for class A. Treated The critical moisture state of the samples corresponds to class D (Table 4 & 5).

Table 4. The test classification of critical moisture condition.

Product	Class
Untreated wood samples	A
BIO-ECO TT40	D

Table 5. Results after Twelve and thirteen weeks (95 and 85%).

Product	95%	Assessmen t	90%	Assessmen t	85%	Assessment	80%	Assessment
Untreat ed	Sample no.	4	Sample no.	4	Sampl e no.	3	Sample no.	2
	113		78		29		1	
Untreated	114	4	79	4	30	3	2	2
Untreated	115	4	80	4	31	3	3	2
Untreated	116	4	81	4	32	3	4	2
Untreated	117	4	82	4	33	3	5	2
Untreated	118	4	83	4	34	3	6	1
Untreated	119	4	84	4	35	3	7	2
BIO- ECO TT40	120	3	85	1	36	0	8	0
BIO- ECO TT40	121	2	86	0	37	0	9	0
BIO- ECO TT40	122	3	87	2	38	0	10	0
BIO- ECO TT40	123	3	88	1	39	0	11	0
BIO- ECO TT40	124	3	89	1	40	0	12	0
BIO- ECO TT40	125	3	90	0	41	0	13	0
BIO- ECO TT40	126	3	91	0	42	0	14	0

Figure 1. Calculated critically moisture condition at various temperatures for the untreated the samples.
. Dashed yellow line is the lower level of the critical moisture condition.

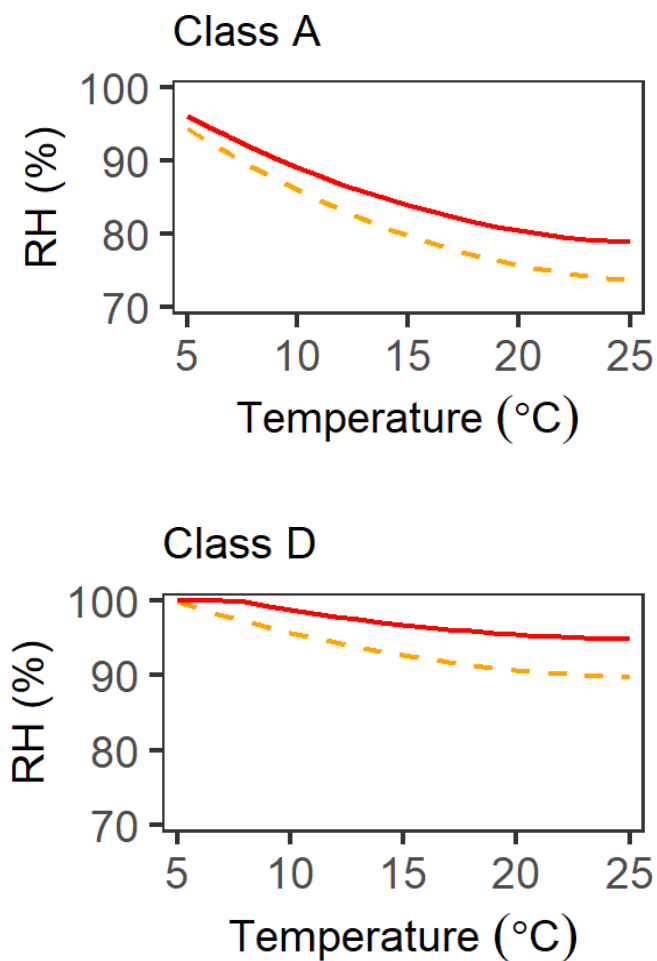


Figure 2. Calculated critically moisture condition at various temperatures for the treated the samples. Dashed yellow line is the lower level of the critical moisture condition.

The results described in this report applies only for the tried the pieces of material and during the conditions that prevailed during this test. Contamination with organic content on the material surfaces reduces resistance to mold growth.

RISE Research Institutes often Sweden AB
Construction and real estate - Indoor environment and building physics

Performed by


Gunilla Book

Reviewed of


Eve
Sikander

Signed by: Eva Sikander
Reason: Granskare
Date & Time: 2021-01-28 09:13:17 +01:00