NATIONAL BUREAU OF STANDARDS REPORT

7382

Investigation of Fungus-Resistance Tests for Shower Pan Materials

by

Selden D. Cole
and
Paul R. Achenbach

Report to

Federal Housing Administration
Washington, D.C.



U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

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Building Research Division

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Apparatus, Culture Medium, and Test Fungi

The apparatus, culture medium, and test fungi used for these tests were as follows:

(a) The autoclave was capable of maintaining an exhaust temperature of 121 ± 2°C (249.8 ± 3.6°F) at a pressure of 15 lbs/sq in. for sterilizing of the culture medium and the glassware.

(b) The Petri dishes used for qualitative tests were 10 cm. in diameter.

(c) A sterile room is desirable, but was not available for these tests. The tests were performed in an isolated one-room building with a low dust content.

(d) The incubation chambers were Petri dishes with plastic covers and maintained at a temperature between 75°F and 80°F.

(e) The culture medium consisted of:

NH_3NO_3	3.0 grams
KH_2PO_4	2.5 grams
K_2HPO_4	2.0 grams
$MgSO_4.7H_2O$	2.0 grams
Agar	20 grams
Distilled water to make	1000 ml.

The pH of the medium was adjusted to the range 6.4 to 6.8 with HCl or NaOH as required. The medium was sterilized in Petri dishes.

(f) The first fungus used was Chaetomium globosum, A.T.C.C. 6205.

(g) The second fungus used was Aspergillus niger, A.T.C.C. 6275.

(h) Subcultures were prepared in sterilized Petri dishes, and the inoculum was prepared from the ripe-fruiting subcultures. The spores were transferred with a sterilized nichrome wire loop, to an Erlenmeyer flask containing about 5 glass beads 1/4 inch in diameter, and 10 ml of distilled water. The mixture was shaken to break up the spores and then diluted to 200 ml. The

Chaetomium globosum subculture was prepared on Whatman filter paper placed on the hardened agar. The Aspergillus niger subculture was similarly prepared except that 30 grams of brown sugar was added to the 1000 ml of culture medium before sterilization and hardening.

Test Procedure:

Specimens, 1 1/2 inches square, were cut from the shower pan samples and from a 3/16-inch thick cement asbestos board.

Four specimens of each sample were used with each mold inoculum unless it was obvious that both sides of a sample were the same material. Under aseptic conditions, one half of the specimens were separately dipped in 70 percent ethanol for a few seconds, rinsed thoroughly in distilled water, and placed firmly on the solidified agar medium previously prepared in the 10 cm Petri dishes. A narrow strip of sterile filter paper was placed in each dish at the same time but at a maximum distance from the specimen. With a sterile pipette, approximately 1 1/2 ml of inoculum was distributed over the surface of each specimen, filter paper, and medium in each dish as it was prepared. Each Petri dish contained a strip of Whatman filter paper as a control, but in addition a control dish of filter paper on medium was prepared for each mold. The other half of the specimens were placed on the agar medium in the Petri dishes and inoculated in the same manner without being previously dipped in ethanol and rinsed.

The covered Petri dishes were incubated for about two weeks at a temperature between 75° and 80°F in a room with uncontrolled humidity.

Test Results

At the end of the incubation period the following results were observed:

Table 1

Chaetomium Globosum Inoculation

Specimen	Ethanol-Treated	Untreated
Copper foil-paper laminate		
Foil up	No specimen	No growth
Paper up	Mold-covered	Mold-covered
Four-layer paper laminate, with thin plastic coating on one side		
Plastic up	Mold at edges only	Mold at edges only
Paper up	Mold-covered	Mold-covered
Polyvinyl chloride sheet (green)	Few specks on surface	Few specks on surface
Polyvinylidene chloride sheet (black)	No growth	No growth
Polyethylene paper laminate (2 layers)		
Plastic up	Edges only	Edges only
Paper up	Mold-covered	Mold-covered
Filter paper control and filter paper strips	Mold-covered	No specimen
Cement asbestos board	No growth	No specimen

Table 2

Aspergillus Niger Inoculation

Specimen	Ethanol-Treated	Untreated
Copper foil-paper laminate		
Foil up	No specimen	Some growth at edges
Paper up	Mold-covered	Mold-covered
Four-layer paper laminate, plastic surface one side		
Plastic up	Some growth at edges	Some growth at edges
Paper up	Mold-covered	Mold-covered
Polyvinyl chloride sheet (green)	Some growth on medium flowed onto thin sheet	Trace of growth on soiled spots

Table 2 (contd.)

Specimen	Ethanol-Treated	Untreated
Polyvinylidene chloride sheet (black)	Mold specks on stained spots	Trace of growth on uncleaned surface
Polyethylene paper laminate (2 layers)		
Plastic up	Edges only	Edges only
Paper up	Some growth	Nearly mold-covered
Control with filter paper strips	Excellent growth	No specimen
Cement asbestos board	No growth	No specimen

The results in Tables 1 and 2 indicate that the paper components in all shower pan materials became mold-covered during the incubation period of about two weeks when inoculated with either of the two fungi, the plastic materials showed no mold growth in some cases and a few specks or a trace of growth in other cases, and the metal and cement-asbestos specimens showed no mold growth. The polyvinylidene chloride sheet was slightly susceptible to growth of Aspergillus niger but not to Chaetomium globosum, and the paper component of the polyethylene-paper laminate appeared to be somewhat more susceptible to growth of Chaetomium globosum than to Aspergillus niger. The polyvinyl chloride sheets showed specks or traces of both types of mold after two weeks incubation and a fairly general, though not dense, mold growth after seven weeks incubation. The other materials showed no significant change between two and seven weeks incubation.

In general, there was little observable difference in the amount of mold on the treated and untreated specimens at the end of the incubation period. There was slightly more growth of Aspergillus niger on the untreated specimens than on the treated specimens of polyvinylidene chloride and on the paper side of the polyethylene-paper laminate.

There was some tendency for the mold growth on the culture medium to overlap the edges of the thinner laminates even when the center of the exposed surface showed no visible mold growth.

Discussion and Conclusions:

The fungus-resistance test described in this report is not difficult to perform, once the apparatus and materials have been assembled.

A covered Petri dish is adequate as an incubation chamber for small specimens, and provides a convenient method for maintaining interior conditions at near saturation.

The culture medium described in this report is not critical with respect to the proportions of the ingredients, as several salt-agar media are known to support mold growth for pH values up to 6.8. Aspergillus niger propagates better if brown sugar is added to the culture medium in the proportions indicated. The use of a sterilized metal loop for transferring the spores of the subculture and glass beads for forcing the spores into suspension appears to be preferable to a camel's-hair brush for these purposes especially from the standpoint of ease in sterilization.

Preconditioning the specimens by dipping in ethanol prior to inoculation is desirable to minimize the presence of extraneous matter on the surfaces of the specimens. The preconditioning at 250°F specified for duct specimens would not be satisfactory for shower pan materials, especially those employing plastics.

Recommendations

It is recommended that materials which become generally covered with either Chaetomium globosum or Aspergillus niger during a 4-week incubation period with the test procedure described herein, be considered to have inadequate fungus resistance. Materials with no mold growth or which reveal a few specks of mold in an irregular pattern after four weeks incubation should be considered to have acceptable fungus resistance. These requirements should be applied to both sides of a laminated material, but not to the cut edges.

The reasons for recommending that the fungus-resistance requirement be made applicable to both sides of shower pan materials are as follows. The BRAB Task Group that considered the essential criteria for ducts believed that heating and air conditioning ducts should be tested for mold growth. It is difficult to argue that the exposure of ducts to mold growth would be more severe than the bottom side of a shower pan in crawl spaces. It seems probable that the criteria, other than

the fungus resistance test, recommended for shower pans will permit paper laminates with non-cellulosic materials on the upper side, and that such laminates will be offered in the future. Since this investigation of mold growth on a number of laminates showed that cellulosic materials invariably supported good mold growth and that a very thin layer of some plastic materials would prevent mold growth on paper laminates, and since the cost of adding such a plastic covering to the under side of such materials would be quite small, it is believed that the fungus resistance test should be a requirement on both sides of all materials.

It is recommended that photographs of the specimens, taken at the end of the 4-week incubation period, be required as a part of the test report on fungus resistance. Each photograph should be taken with a scale laid beside the specimen to indicate its size, and the light conditions should be such that the photograph reveals the nature and height of the fungus growth on the surface of the material. The photograph should be enlarged so the specimen will be of a 6x6-inch size in the enlargement.

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Physical Chemistry. Thermochemistry. Surface Chemistry. Organic Chemistry. Molecular Spectroscopy. Molecular Kinetics. Mass Spectrometry.

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Ionosphere Research and Propagation. Low Frequency and Very Low Frequency Research. Ionosphere Research. Prediction Services. Sun-Earth Relationships. Field Engineering. Radio Warning Services.

Radio Propagation Engineering. Data Reduction Instrumentation. Radio Noise. Tropospheric Measurements. Tropospheric Analysis. Propagation-Terrain Effects. Radio-Meteorology. Lower Atmosphere Physics.

Radio Standards. High Frequency Electrical Standards. Radio Broadcast Service. Radio and Microwave Materials. Atomic Frequency and Time Interval Standards. Electronic Calibration Center. Millimeter-Wave Research. Microwave Circuit Standards.

Radio Systems. High Frequency and Very High Frequency Research. Modulation Research. Antenna Research. Navigation Systems.

Upper Atmosphere and Space Physics. Upper Atmosphere and Plasma Physics. Ionosphere and Exosphere Scatter. Airglow and Aurora. Ionospheric Radio Astronomy.


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