

Fact Sheet: Moisture Requirements for Mold Growth

Fungi require water for nutrient absorption and normal metabolic activity. Water requirements for fungi and other microorganisms are usually expressed as water activities (aw). The water activity is equal to 1/100th the equilibrium relative humidity when expressed as a percent. Relative humidity is an expression of how much moisture is in the air as a percentage of the total moisture the air can contain at the current temperature. For example, if the air has all the water vapor that it can contain at a given temperature, the relative humidity is 100%; if the air has only half of the vapor that it can contain at a given temperature, the relative humidity is 50%. Equilibrium relative humidity is the humidity of a tested material while at the same vapor pressure as the ambient environment. In other words, moisture is not migrating to or away from the tested material.

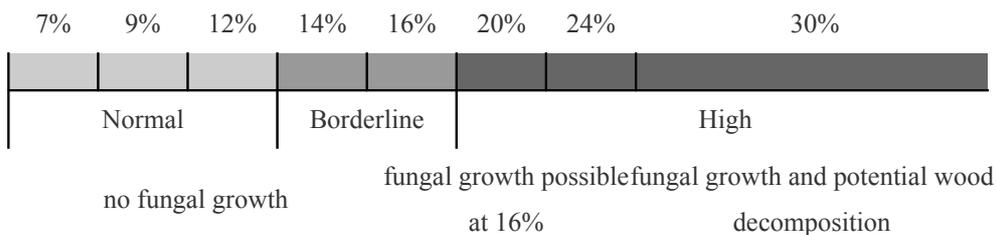
Water activity of 0.60 is considered the lower limits for microbial growth. Below 0.55 all metabolic activity ceases and DNA is denatured.

- <0.9 most bacterial activity inhibited
- <0.8 most yeast activity inhibited
- <0.7 most fungal activity inhibited
- <0.6 all microbial activity inhibited

Fungi Growth and Wood Moisture Content

Normal moisture levels for wood building materials typically range from 8 to 14%. It is widely recognized that significant decomposition by wood-rotting fungi will occur above the fiber saturation point at 28-30% moisture content. Depending on the type fungi present, pre-conditioning and limited decomposition may occur at moisture levels as low as 20%. Several non-rotting fungi, including certain species of *Aspergillus* and *Penicillium*, grow at water activities as low as 0.70, which correspond to wood moisture contents below 15%. Optimal water activities for these fungi range from 0.80 to 0.90, which correspond to wood moisture contents of 16-20%.

Wood Moisture Content (for a typical softwood)



A moisture content of 16% is well-recognized as the limit for surface mold.

[Lstiburek, J. 2002. Moisture control for buildings. ASHRAE Journal. February 2002.](#)

[Andrews, S. 2002. Mold: a growing concern. Professional Builder. April 2002.](#)

Fungi differ in their specific requirements for water.

Water activities vary based on the species and substrate in question. Most molds grow best at 0.80 to 0.95. It should be noted that water activity and relative humidity are not the same as "percent moisture", which is simply the percent of water within a given substrate.

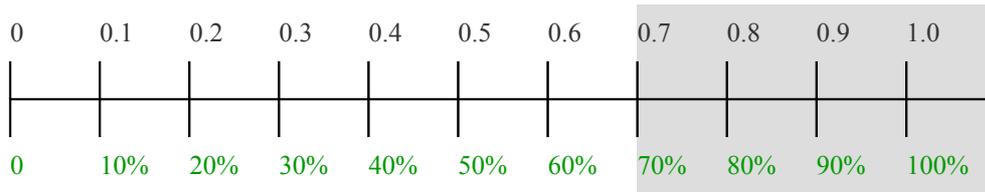
Fungus	Water Activity (a_w)
Saccharomyces	0.61 - 0.95
Aspergillus	0.65 - 0.98
Wallemia	0.65 - 0.87
Penicillium	0.78 - 0.86
Alternaria	0.84 - 0.88
Cladosporium	0.82 - 0.88
Fusarium	0.86 - 0.91
Mucor	0.90 - 0.94
Rhizopus	0.90 - 0.93
Stachybotrys	0.91 - 0.94

Water requirements may be met by high relative humidity.

Generally speaking, most molds will grow when the relative humidity of the air is 70% or greater. Relative humidity is affected by temperature; so when outdoor air cools from 70° to 50°F, the relative humidity may increase from 40% to 70%. Differences in ambient temperature (e.g. indoor versus outdoor temperatures) can therefore cause condensation to form on cooler surfaces, especially in areas such as windows, crawlspaces, and attics where cooler and warmer air meet. Condensation occurs when the dew point is reached (the temperature at which water will condense from the air if the air mass were cooled). When the relative humidity is high, the dew point will be close to the air temperature. At 100% relative humidity, the dew point is equal to the air temperature. When the relative humidity is low, the dew point is much lower than the air temperature.

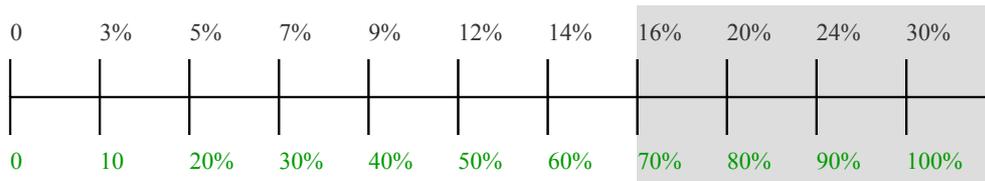
The shaded ranges of each moisture spectrum represent suitable conditions for fungal growth.

Water Activity (a_w)



Equilibrium Relative Humidity

Wood Moisture Content (for a typical softwood)



Equilibrium Relative Humidity

Fungal spores may remain viable even when dried or chemically treated.

Fungi will start to make spores when the nutrients of the given substrate are exploited or when triggered by certain environmental factors. Usually this occurs within 72 hours under high moisture conditions. Under unfavorable conditions, mold spores can remain dormant even in extreme environments. Spores also do not have the same water requirements as the vegetative cells and hyphae. If left undisturbed, spores may survive for months or even decades. As moisture is once again introduced, the spores germinate to give rise to renewed vegetative growth and a new progeny of spores.