

### The Progression of Mold Proliferation In the Indoor Environment.

Water is essential for all life forms to grow including fungi. The optimum growth varies depending on the species of mold and is also influenced by factors such as temperature, relative humidity ( $A_w$ ) and type of nutrients available. Scientists establish the water activity values by allowing a growth medium to reach equilibrium at a given relative humidity and observing growth performance for that organism. Therefore,  $A_w$  values are equivalent to **relative humidity**:  $A_w = \%RH/100$ .

When a typical indoor environment is properly maintained mold spores in the home do not accumulate to atypical ranges of flora. Keep in mind that the background ecology of the indoor environment also contains insect parts, bacteria, viable and non-viable spores. This indoor ecology is identified in S520<sup>1</sup> as Condition 1. Condition 2 is defined as settled spores have accumulated in the environment, presumably from a Condition 3 environment, which exhibits actual mold growth, hidden or not.

For a Condition 3 environment to exist, organic substrates, water and oxygen need to be present. This growth cycle is the basis for organic decomposition mechanisms. As water levels change, ecologies change and adapt to the changing environment. The amount of water available for microorganism growth, or water activity, dictates the fungal ecology of the microenvironment.

### References:

1. *Standard and Reference Guide for Professional Mold Remediation*, IICRC S520, First Ed., December, 2003, Institute of Inspection, Cleaning, Restoration Certification.
2. <http://www.moldacrossamerica.org/glossaryA.htm>.
3. B. Flannigan, R.A. Samson, and J.D. Miller (Ed).2001. Microorganisms in home and indoor work environments. Taylor & Francis, New York, N.Y.
4. [http://www.mold-survivor.com/mold\\_after\\_the\\_storm.htm](http://www.mold-survivor.com/mold_after_the_storm.htm).
5. [http://www.envirochex.com/Mold/About\\_Mold\\_Water.htm](http://www.envirochex.com/Mold/About_Mold_Water.htm).
6. Ayerst, G. (1969) The effects of moisture and temperature on growth and spore germination in some fungi. J. Stored Prod.Res. 5,127-141.

### Water Activity Tables:

<b>Extremely Dry loving Fungal species ( Xerophilic):</b>	<b><math>A_w &lt; 0.75</math></b>
<i>Aspergillus penicillioides</i>	0.73-0.77
<i>Aspergillus restrictus</i>	0.71-0.75
<i>Aspergillus wentii</i>	0.73-0.75
<i>Eurotium amstelodami</i>	0.71-0.76
<i>Eurotium chevalieri</i>	0.71-0.73
<i>Eurotium. echinulatum</i>	0.64
<i>Eurotium repens</i>	0.72-0.74
<i>Eurotium rubrum</i>	0.70-0.71
<i>Wallemia sebi</i>	0.69-0.75

<b>Moderately Dry loving Fungal species ( Xerophilic):</b>	<b><math>A_w &lt; 0.75 - 0.79</math></b>
<i>Aspergillus candidus</i>	0.75-0.78
<i>Aspergillus flavus</i>	0.78-0.80
<i>Aspergillus ochraceus</i>	0.76-0.83
<i>Aspergillus sydowii</i>	0.78; 0.81
<i>Aspergillus tamarii</i>	0.78

<i>Aspergillus terreus</i>	0.78
<i>Aspergillus versicolor</i>	0.78; 0.74 <sup>e</sup> ; 0.75 <sup>d</sup> ; 0.79 <sup>b</sup>
<i>Exophiala werneckii</i>	0.77-0.78
<i>Paecilomyces variotii</i>	0.79-0.84
<i>Penicillium aurantiogriseum</i>	0.79-0.85
<i>Penicillium brevicompactum</i>	0.78-0.82

<b>Slightly Dry loving Fungal species (Xerophilic):</b>	<b>Aw &lt;0.80-0.89</b>
<i>Absidia corymbifera</i>	0.88-0.89
<i>Alternaria alternata</i>	0.85-0.88
<i>Aspergillus clavatus</i>	0.85; 0.88 <sup>d</sup>
<i>Aspergillus fumigatus</i>	0.85-0.94
<i>Aspergillus niger</i>	0.77 ->0.97
<i>Aureobasidium pullulans</i>	0.87-0.89 <sup>b</sup>
<i>Chrysonilia sitophila</i>	0.88-0.90 <sup>a</sup>
<i>Cladosporium cladosporioides</i>	0.86-0.88; 0.83-0.84 <sup>b</sup>
<i>Cladosporium herbarum</i>	0.85-0.88
<i>Cladosporium sphaerospermum</i>	0.83-0.84 <sup>b</sup>
<i>Epicoccum nigrum</i>	0.86-0.90
<i>Fusarium culmorum</i>	0.87-0.91
<i>Fusarium graminearum</i>	0.89
<i>Fusarium moniliforme</i>	0.87 <sup>*a</sup> ; 0.89-0.91 <sup>b</sup>
<i>Fusarium so/ani</i>	0.87-0.90
<i>Mucor plumbeus</i>	0.87-0.93 <sup>''</sup>
<i>Penicillium citrinum</i>	0.80-0.82
<i>Penicillium commune</i>	0.83
<i>Penicillium expansum</i>	0.82-0.85
<i>Penicillium fellutanum</i>	0.80 <sup>e</sup>
<i>Penicillium oxalicum</i>	0.88
<i>Penicillium rugulosum</i>	0.85; 0.80 <sup>d</sup>
<i>Penicillium viridicatum</i>	0.81 <sup>c</sup>
<i>Ulocladium chartarum</i>	0.89 <sup>b</sup>

<b>Water loving Fungal species (Hydrophilic):</b>	<b>Aw ≥ 0.90</b>
<i>Aspergillus spp.</i>	0.71 – 0.94
<i>Aspergillus fumigatus</i>	0.85-0.94
<i>Aspergillus niger</i>	0.77 ->0.97
<i>Botrytis cinerea</i>	0.93-0.95
<i>Byssochlamys spp.</i>	0.84-0.92
<i>Chaetomium spp.</i>	>0.90
<i>Geomyces pannorum</i>	0.92; 0.89 <sup>b</sup>
<i>Memmoniella spp.</i>	>0.90
<i>Mucor racemosus</i>	0.94; 0.92 <sup>d</sup>
<i>Neosartorya fischeri</i>	0.925
<i>Rhizopus stolonifer</i>	0.93
<i>Sistotrema brinkmannii</i>	0.96-0.97 <sup>b</sup>
<i>Stachybotrys chartarum</i>	0.94; 0.91 -0.93 <sup>b</sup>
<i>Ulocladium chartarum</i>	0.89 <sup>b</sup>
<i>Verticillium lecanii</i>	0.90

\*Spore germination, but growth not observed; (1989);<sup>c</sup> Misli vec and Tuite (1970);<sup>e</sup> Panasenko (1967);<sup>c</sup> Snow (1949).<sup>a</sup> Armolik and Dickson (1956);<sup>b</sup> Grant *et al*