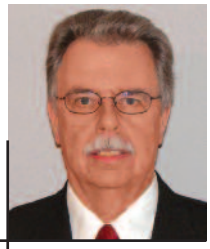
Restorer's Corner

Fine-tune your disaster restoration skills via Q&A with Cleanfax® magazine's expert consultants.



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By Richard Driscoll

Q: *I am finding that some of my water jobs quickly get a musty odor, much like a moldy smell, even when I arrive the same day the loss occurs. Why can I smell mold that quickly?*

A: Actually, mold growth does not begin to become microscopically detectable until eight to 10 days after the water incursion, and is not visible until 18 to 20 days.

For more information on this, before we get into this particular discussion about the cause of some of these odors you are encountering, please see the article in the May issue of *Cleanfax* magazine for the peer reviewed scientific documentation.

As a water damage technician, we show up at a water job and there is that tell-tale musty, moldy odor. We may even start the drying process when there is no odor, and the next day that musty odor has appeared.

What is causing this odor? If the odor is not caused by mold, then what is causing it? The answer is probably *bacteria*.

It is true that the odor could be from *old* mold. Assuming a normal response time to a water loss of 12 to 24 hours, then for the odor to be coming from mold would mean that the mold was already there before the water loss — thus a pre-existing condition. So if mold is not visible, the source of the odor is probably bacteria.

Bacteria basics

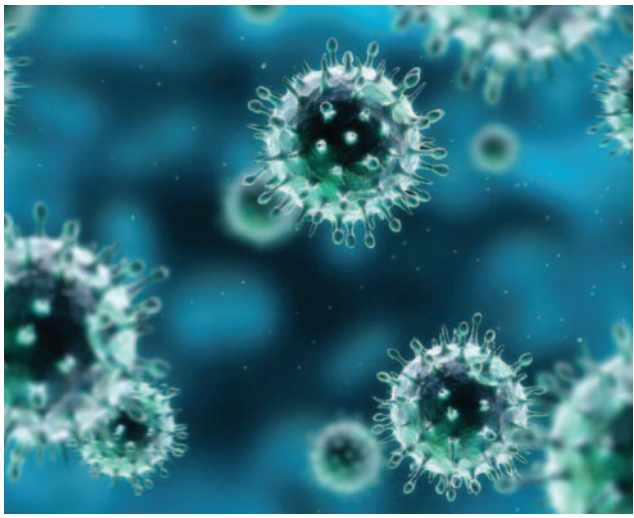
Before getting into what to do about the bacteria that is causing the odor at the water loss, we need to understand what bacteria are, and if they pose a health hazard.

According to paleontologists, who are scientists that study the history of life on Earth, bacteria were the first life form to develop on Earth.

Bacteria have the largest numbers of any life form on earth. It is estimated that there are 5 x 10 to the 30th power of bacteria on Earth (this number is a 5 followed by 30 zeros). (1)

The microbiologists who study bacteria estimate that there are 10,000,000 species on earth, with only about 9,000 having been identified. In comparison, there are about 5,500 identified species of mammals on earth.

Bacteria live everywhere on Earth, and live *on* everything on earth. Actually "cataloging" all bacterial life will probably never be accomplished. If you went into your back yard and took a shovel of dirt, in that shovel would be an estimated 2.2 million bacteria. (1)



Looking at bacteria from a different perspective, a weight perspective, here are some interesting statistics:

- There are about 6.8 billion humans on Earth, and if each human weighs an estimated 160 pounds, then the total weight of the human population on earth

Questions Please

There's nothing more frustrating than having a question without access to an expert answer. That's why *Cleanfax*® magazine provides this monthly feature entitled "Restorer's Corner." Instead of choosing a topic each month, *Cleanfax* editorial staff is leaving that up to you, the readers. Do you have a disaster restoration question you would like to ask? Simply e-mail it to Senior Editor Jeff Cross at jcross@cleanfax.com or send it to Jeff Cross, 193 Purple Finch Loop, Pataskala, OH 43062.

KEYWORD mold

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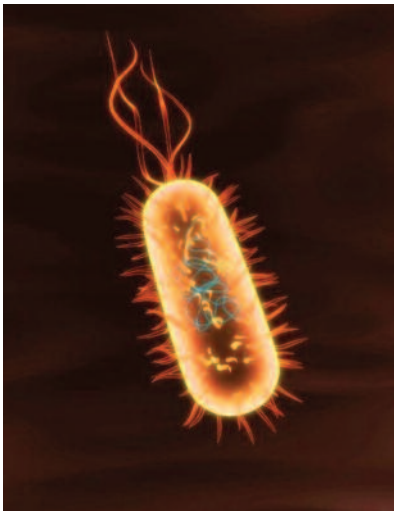
would be about 1.1 x 10^{12} pounds, this 1.1 x 10 to the 12th pounds. As an example of how big this number is, if we stacked one dollar bills on top of each other, this amount of 1.1 x 10^{12} of dollar bills would reach the moon, which is about 240,000 miles from Earth.

- The total weight of bacteria on Earth is estimated to weigh 1 x 10 to the 15th pounds. (1)
- Thus the total weight of bacteria on Earth is much larger than the weight of all the humans on Earth.



Bacteria have always been here and have always been very abundant.

When most of us hear the word bacteria, we have an immediate negative reaction. The word "bacteria" to most of us means sickness, illness and disease, among others. Nothing could be further from the truth. If it was not for bacteria, the human race would not exist. Bacteria are 100 percent essential for us, as humans, to live. A few examples:

- Bacteria on your skin (2)
- 1,000 different species
- Different species live on different regions of the human body
- Many act as defense mechanism against pathogenic bacteria
- Bacteria in your mouth (3)
- 500 to 1,000 different species
- Even after brushing and rising with mouthwash, thus killing most bacteria, the bacteria regenerate in about two hours (which is a good thing)
- These bacteria are a major bodily defense mechanism
- Bacteria in your large intestine (4)
- 700 different species of bacteria, weighing about 4 pounds
- Produce vitamin K, vitamin B, thiamine, riboflavin
- Digest fiber

Bad bacteria

While there are thousands of bacteria which live on us, in us, and protect us, there are some "bad" ones.

There are hundreds of species of bacteria that can, and do, cause sickness and disease. These are called pathogenic. The ones we hear about most often are the likes of *Escherichia coli (E-coli), Salmonella, Shigella, Streptococcus, pneumonia, tuberculosis, cholera,* etc.

And, we have just seen an apparently new bacteria strain of E-coli in Europe.

In most buildings, the common types of bacteria that are present include micrococcus, staphylococcus and bacillus. All of these live on our human skin and are mostly benign.

The reason these bacteria are found in buildings is that we, as humans, shed our surface layer of skin and these bacteria are

also shed with the dead skin cells. So, while there can be pathogenic bacteria in buildings, they are normally not present.

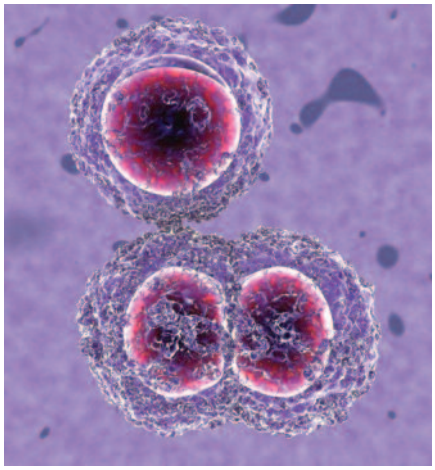
While pathogenic bacteria are cause for concern, they can be destroyed by the proper use of biocides/antimicrobials, or by taking away one of their requirements for life, either their food source, or water.

> "Bacteria live everywhere on Earth, and live on everything on earth."

Bacteria growth

Bacteria are single-celled forms of life that are very small in size, about 0.2 to 1 micrometers in diameter. As a comparison, a human hair is 40 micrometers to 120 micrometers in diameter and photo copy paper is about 100 micrometers.

Bacteria reproduce by a process that is called binary fission, which means they split from one cell into two cells. Many species of bacteria can reproduce almost continually.



The "splitting" can occur as fast as every 15 minutes, which is much quicker than mold reproduces. While this does not seem very quick, watch the math: (5)

- Start with one cell, 15 minutes = 2 cells, 30 minutes = 4 cells, 45 minutes = 8 cells, 60 minutes = 16 cells
- Four hours after the start = 65,536 cells
- Eight hours after the start = 4,294,967,296 cells, almost 4.3 billion cells.

With this reproduction rate, the quantity of bacteria literally explodes. Even if we respond to the water loss eight hours after the event, we are caught behind the curve.

The numbers go beyond imagination if you look at 24 hours, since the quantity can keep doubling every 15 minutes.

With bacterial growth rates that are exploding at a water loss, they have to obtain energy to survive, grow and continue their reproduction.

Bacteria obtain energy from digestion. Bacteria's digestion occurs outside of the organism and one of the by-products of this process is off-gassing, which creates the musty odor that we probably smell at the routine water loss.

The odor that becomes noticeable at a water loss can be very similar to odor given by mold. These odors are known as microbiological volatile organic compounds (MVOCs). It is this off-gassing that could be the odor that is present when we arrive and/or could be the odor that appears on day two of the water loss.

Many times, you will hear water damage technicians say something like, "I am applying a biocide to stop the odor from showing up on day two."

What the technician is, in effect, doing is applying a biocide to kill the *bacteria* which eliminates the generation of MVOCs.

Fighting the bacteria

The ways to minimize, reduce or eliminate bacteria are by proper cleaning, drying and the application of biocides.

There are many different formulations of effective biocides that are routinely used to kill bacteria on a water loss. Many of these solutions use, as their primary "killing" chemicals, the same chemicals that we find in everyday life. Here are some examples:

- Hydrogen peroxide used on cuts to kill bacteria
- Phenols, which are used in biocides, are also the same used in a popular mouth wash
- The orange colored biocide that is used by phlebotomists on your arm before taking blood is iodine, which is known as an iodophor in chemical terms
- Quaternary ammonium compounds are used in household cleaners/disinfectants that are used in bathrooms and kitchens
- Hypo-chlorites that are in solutions are also used in your clothes washer to clean whites, commonly called bleach.

While there is justifiable concern about misuse of biocides, most of the biocides used in our industry have been around for years and when used properly can kill both bacteria and mold and do not pose a human health risk.

"Killing" mold is not an acceptable method of mold remediation, but that is for another article. Killing bacteria with biocides is a very acceptable method of decontamination. It is routinely done in hospitals, doctors/dentists offices, food process facilities, restaurants, etc.

Bacteria, like all forms of life on Earth, needs water to live. Below is a table showing different levels of water activity and the type of microbial life each level supports.

Water activity is the water that is available to support microbial life at the very surface level of a material, which is the location where we find microbial growth.

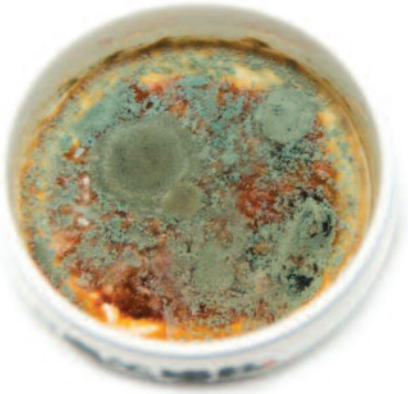
Water activity and moisture content are somewhat related, but a full discussion is for another article.

Water Activity (wetness) – Minimum to support	Life Form Supported
0.95	Bacteria
0.88	Most fungi
0.66 to 0.70	Mold: Penicillium, Aspergillus

As can be seen from this chart, bacteria need a lot of water to live. In fact, bacteria needs more water to live than does mold. As a comparison, the average human should consume 25 ounces of water per day. Less than this amount may lead to health problems. With water activity, if the amount of water is below the above values, then there is not enough water for microbial life to live.

When water is taken away from bacteria, they die. This is different from mold. When water is taken away from mold, mold goes into a state called dormancy. Mold, in effect, goes into a waiting pattern for water to return — it does not die.

Thus, drying can be an effective bacterial killing method.



This is a petri dish that has been "seeded" with what was obtained by air sampling, and then "encouraged" to grow. What is visible is a combination of mold and bacteria.

Musty odors

Back to our tell-tale odor at the water loss. That musty odor can be a sign of mold growth, which may not be visible. Mold can be living and growing inside wall cavities, under cabinets, under carpet/pad and in other "hidden" locations.

However, the odor you encounter is more likely caused by bacteria that are ever-present in homes and grow very rapidly when exposed to water.

If you find mold right after a water loss, it is most likely pre-existing, and not from the immediate water loss.

The best method to reduce bacteria and their odors and potential negative health impacts is by:

- Properly cleaning the affected areas
- Drying the structure
- Appropriate use of biocides.

If a structure is clean and dry, then there cannot be any microbial life.

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