Joe Spurgeon, Ph.D., July 30, 2016

COLLECTING AND INTERPRETING SURFACE DUST SAMPLES

How are surface dust samples interpreted?

How surface dust samples are collected is a critical factor; and determines if the sample results can be associated with the condition of the surface that was sampled, and ultimately with the condition of the indoor environment. The following example involves the collection of dust from a fabric-covered couch. It illustrates the importance of selecting an appropriate (1) sample collection method, and then (2) data-interpretation method [yes, there are multiple methods to choose from].

First, what's the question the sample was intended to answer? For example: Is the couch contaminated with mold? Answering this question requires the use of:

1. A sample collection method that is capable of detecting the mold spores; and
2. A data-interpretation method that can distinguish between a normal and a contaminated couch.

Distinguishing between an uncontaminated and contaminated couch may itself not be an easy task. But what if the question is not only is it contaminated, but can the couch be cleaned or should it be discarded? This is a more complicated question, and requires the use of:

1. A sampling method that collects both surface mold;
2. A second sampling method that collects both surface and also deep-seated mold in the interior of the couch;
3. A data-interpretation method that can distinguish between surface contamination (which can typically be cleaned; so clean couch) and deep-seated colonization (which typically cannot be cleaned; so discard couch).

So, what's the difference between "contaminated" and "colonized"? Contamination refers to the condition in which airborne mold spores settle out of the air onto a dry surface [not exposed to dampness or wetness]. The surface has remained dry, the mold spores are not expected to grow, and the spores can typically be removed by HEPA-vacuuming and cleaning [Decision: contaminated items can typically be cleaned and returned to service].

Colonization refers to the condition is which the item has been damp or wet, and mold has been growing on the surface material and/or within the interior of the item. Once mold growth has occurred the item cannot be cleaned, and should be discarded [Decision: colonized items shall be discarded]. Therefore, in order to classify a soft-surface item as contaminated or colonized, a sample collection method is required that can differentiate between these two conditions. Once the condition is known, then a clean-discard decision can be made based on objective criteria.

A sample collection method that meets these criteria is the differential sampling method [www.expertonmold.com]. It uses a closed-face filter cassette to sample the surface of the item, and an open-face filter cassette to sample both the surface and interior of the item. The two sample results are compared, and the difference [the amount of mold hidden inside the item] is used to classify the item as contaminated or colonized items.

If spring cleaning occurs after sampling for settled dust, does the previous test result apply to current conditions?

It may apply. In general, microbial contaminants are contained in the dust, they are not embedded in the fabric fibers. If there were 10,000 spores per gram of dust prior to cleaning, for example, there would still be 10,000 spores per gram of dust after cleaning. What will have changed is the amount of dust in the carpet, on the couch cushions, etc. Since the amount of dust will be reduced, the cleaning will probably have reduced the occupant exposure potential. However, new dust immediately begins to accumulate on those same surfaces. So it's possible the sample result obtained prior to cleaning will be representative of typical, average conditions.

A sample result describes the conditions that existed when the sample was collected. Common sense determines if a previous sample result may be used to describe current conditions. Has anything in the indoor environment changed? If not, then the previous result can probably be applied to current conditions. If any substantial changes to the indoor environment have occurred [water intrusions, pets, season, humidity, air supply, new vacuum cleaner, health status], then probably not. The types and concentrations of mold, and the concentration of dust mites (for example), may vary with the seasons. So, tracking seasonal changes (quarterly sampling) may provide useful information for some limited purposes. However, although this is an option, periodic baseline sampling is not recommended unless there is a rational reason for doing it.

I did two ERMI tests two weeks apart, one on one side of the bed and the second on the other side, with no cleaning in between. One score was passing, one failing. How can I understand these results?

This inquiry is composed of two separate questions:

1. Is this much variation in sample results, and assessment of condition, to be expected?
2. Are ERMI scores relevant to assessing the condition of the indoor environment?

First, obtaining different sample results in this example should not be surprising. This may simply be due to the normal variation that is commonly observed in environmental samples. The natural inclination is to collect multiple samples (the more the better). However, collecting a large number of samples in not necessarily beneficial, nor encouraged. This approach may simply generate a large number of sample results that don't agree, as in this example. A better approach may be to collect fewer samples, but to collect "composite" samples.

Composite samples should only be collected when justified and appropriate. A composite is a sample that has been collected from multiple locations using one sampling device.

First, identify the "conditional area" to be sampled. Is the concern with only the master bedroom carpet, all the carpeting on the first floor, or all the carpets in the residence? Only collect a composite from the identified conditional area, since the sample result will apply to the entire "area" that was sampled.

If a composite sample were collected from the master bedroom carpet, the result (and assessment) would apply to the entire carpet. In the above example, the area of concern might be narrowly defined as the carpet beneath a potentially leaking window. If that were the case, then a sample might only be collected from that limited area of carpet (Is the window leaking, and is it affecting the wall cavity and adjacent carpet?).

The second question asked if ERMI (and by extension HERTSMI) scores were associated with the condition of a carpet, and by extension the indoor environment. This question has been addressed elsewhere in these discussions, but the short answer is "no". When 39 carpet dust samples were examined [www.expertonmold.com], neither ERMI nor HERTSMI scores were associated with the amount of mold in the dust samples; which is typically considered to be a measure of occupant exposure potential. Therefore, it was not clear that the ERMI score was related to occupant exposure potential.

This is not surprising. ERMI scores are calculated by subtracting Group 2 fungi from Group 1 fungi, not by adding them. Therefore, by design, ERMI scores are not representative of the total amount of mold in the indoor environment.

Can surface dust samples detect hidden mold in a wall cavity?

Maybe, but it would be better to collect a wall cavity sample for that purpose. Wall cavity sampling is not typically used to assess settled mold on horizontal surfaces, or to assess occupant exposure. It is best used to determine: (1) if a hidden water intrusion has occurred, (2) define the areas that should be remediated, or (3) identify areas for destructive testing.

I've heard that "*Stachybotrys* is everywhere." Is this true?

Stachybotrys is a natural part of the outdoor environment, and small amounts are almost universally present in our indoor environments. For example, the paper on the surface of drywall is probably post-consumer use paper; which is pre-inoculated with *Stachybotrys* and many other contaminant mold. Just add water and it will grow.

As more sensitive laboratory methods (such as qPCR analysis) become common, low levels of *Stachybotrys* are detected more frequently in samples of household dust. So, was the *Stachybotrys* detected by culturing (less sensitive) or by qPCR analysis (very sensitive)? How much was detected? Was it in the "typical" range or the "amplified" range? When inspecting a residence for mold, inspectors are not actually trying to find mold (it will be detected) – they are trying to find evidence that mold has become amplified in the indoor environment (present in excessive amounts).

DEFINITIONS

Assessment: The structured evaluation of the indoor environment by a qualified professional for evidence of contamination (amplification).

Colony forming unit: A colony is formed when a living (viable) fungal spore is collected on a suitable nutrient and is cultured (grows into a visible mass of mold). The number of spores forming the colony is not known, it may have been a single spore or a clump of 100 spores.

IEP (Indoor Environmental Professional: A person qualified by training and experience to inspect indoor spaces for evidence of substantial water intrusions and/or microbial contaminants.

Microbial contaminants: Contaminants resulting from excessive amounts of mold and bacteria in the indoor environment; include mold, bacteria, mycotoxins, endotoxins, MVOC's.

BASIC CONCEPTS

1st: If we don't use sample collection methods that can be interpreted, then we can't interpret the sample results.

An assessment of the indoor environment by an IEP is based on four elements:

1. Incident history,
2. Occupant interview,
3. Visual inspection, and
4. Sample results.

The IEP gathers information on these four elements, assesses the significance of each piece of information, then generates a mental "score" for the indoor environment. The IEP then assigns an acceptable-unacceptable assessment based on their training and experience.

Most consumers are not knowledgeable about the sample collection methods that are used by the IEP to detect evidence of microbial contamination; and many may not be concerned with this issue. However, we have probably all heard the old adage of "garbage in, garbage out"; and sample results are a primary input into the assessment process. Therefore, it is critically important that the consumer:

- Have a basic understanding of sample collection methods;
- Know when a particular method is or is not appropriate; and
- Be able and willing to participate in the selection of sampling methods [however, with restraint; discuss and ask questions to confirm the IEP's recommendations make sense].

2nd: If we don't use laboratory methods that can be interpreted, then we can't interpret the sample results

After the IEP collects your samples, they will probably be sent to a commercial laboratory for analysis. The samples are typically accompanied by a "Chain of Custody", which not only confirms the integrity of the sample, but also describes the type of analysis the IEP has asked the laboratory to perform. How the samples are analyzed, and how the sample results are reported by the laboratory, may influence the utility of those samples for assessing the significance of any microbial contamination.

A second issue is the quality of the samples that were submitted for analysis, as previously discussed. Applying a sophisticated laboratory method to the analysis of low-quality samples produces low-quality sample results. In this example, the laboratory report may look impressive, but the quality of the numbers included in the report may be inadequate for assessing the condition of the indoor environment.

3rd: If we don't use the appropriate data-interpretation method, then our conclusions may be questionable

An IEP may have two basic tasks: (1) assessing the condition of the indoor environment, and/or (2) assessing occupant exposure potential. These are different tasks, and may require the use of both different sample collection methods and data-interpretation methods. For example, the use of clear cassettes (Air-O-Cell, Allergenco-D, etc.) to collect short-term airborne samples may be appropriate for assessing the condition of indoor spaces, but may not be the best method for assessing occupant exposure potential. Short-term samples tend to be highly variable and the sample results are difficult to interpret. A better option for assessing occupant exposure potential may be to collect long-term airborne samples using filter cassettes. Long-term cassette samples tend to be less variable, and more representative of the average exposure; which is related to inhaled dose and therefore the potential for adverse health effects.

If the objective were to assess airborne contaminants, then three data-interpretation methods could be used to interpret the sample results:

1. Reference: Compare the indoor concentration to the outdoor concentration;
2. Control: Compare concentrations in contaminated areas to those in uncontaminated areas of the property; or
3. Database: Compare the current sample result to previous sample results obtained in a similar indoor environment.

The Reference method is the most commonly used method to interpret airborne samples; and it is the method that will probably be used by the IEP inspecting your house. Unfortunately, it may also be the method with the least utility for relating the sample results to the condition of the indoor environment. The Control Method will probably have more utility for assessing condition compared to the Reference Method, while the Database Method may be preferred for assessing occupant exposure potential.

4th: If we don't use numerical guidelines to interpret sample results, then we can't interpret numerical sample results objectively

There are three kinds of numerical guidelines: (1) unwritten, implicit guidelines that are referred to as professional judgment, (2) written, consensus guidelines supported by recognized professional organizations, and (3) preliminary guidelines based on research and still in development. Professional judgment has been the default method for interpreting the sample results for microbial contaminants. This does not prevent the IEP from interpreting the results, but it does make the interpretation less objective.

The majority of laboratory reports contain numbers – the sample results. The following examples illustrate how sample results are typically reported:

- Airborne samples reported as spores per cubic meter of air (1,000 spores/m^3);
- Carpet dust samples reported as colony forming units per gram of dust (100,000 cfu/g);

- Wall cavity samples reported as spores per cubic meter of air (10,000 spores/m^3).

Each of these “numbers”, the reported sample results, have to be associated with either condition or occupant exposure potential before their significance can be determined. For example, is 1,000 spores/m^3 of airborne mold indicative of a normal or a contaminated indoor environment? Without the ability to associate numerical sample results with either condition or occupant exposure, the IEP cannot interpret the sample results objectively.