A QUICK PRIMER ON THE PERILS OF USING ERMI SAMPLES FOR POST-REMEDIATION VERIFICATION FOR MOLD PROJECTS

Many indoor air quality (IAQ) professionals and numerous laypeople with an interest in mold have heard about a fungal sampling/analysis/interpretation method developed by the EPA called ERMI – Environmental Relative Moldiness Index. Unfortunately, what many individuals do not appreciate with this precision analytical method is that sample collection and data interpretation controversies can place the unsophisticated user at great risk – particularly if ERMI samples are used following fungal clean-up efforts as post-remediation verification.

A Brief Primer on ERMI

According to the EPA's website (http://www.epa.gov/microbes/moldtech.htm#license), the ERMI process "objectively describe(s) the home mold burden". Using a very specific settled dust sampling technique and sophisticated analysis methods that evaluate fungal DNA, the ERMI process produces a unit-less numeric value, which describes the mold burden in a home by comparing a number calculated during the process to the National ERMI scale. Although the math is a bit complicated because it uses logarithms, ERMI samples are reviewed to determine levels of 36 types of mold. From this data, the 26 Group 1 species associated with homes that have water damage are compared to the 10 Group 2 species that are found in homes independent of water damage to form the basis of the ERMI.

The ERMI scale ranges from about -10 to 20 or even higher and is divided into four parts, called quartiles. Homes in the lowest quartile have the lowest mold burden, with each higher quartile indicating the presence of more mold in the home. Accordingly, the fourth quartile indicates homes with the highest mold burden.

Recent Controversy about the Purpose and Value of ERMI Samples

Although the ERMI analytical technology (officially known as mold specific quantitative polymerase chain reaction, or MSQPCR) was first released by the EPA under license in 2000, it was not until 2006 that use of the process in the mold remediation industry really started to heat up. Approved labs use the patented technology to identify specific types of mold and pay a royalty on each sample. Some labs state in their advertisements that the ERMI sample analysis and interpretation process is "EPA approved"; however, the licensing of the technology to properly identify mold DNA does not mean that the EPA is endorsing the entire ERMI process.

This confusion was so great that last August the EPA's Office of Inspector General issued a report entitled, *Public May Be Making Indoor Mold Cleanup Decisions Based on EPA Tool Developed Only for Research Applications*. The report was quite critical of both the EPA and some of the licensed laboratories. The conclusion was blunt in stating, "The EPA readily acknowledged that it had not validated MSQPCR or ERMI for public use." The Inspector General went on to note that "there is a risk the public may make inappropriate decisions regarding indoor mold based on the belief that the ERMI tool has been fully validated by the EPA for public use."

So, if the agency that developed it says that it considers MSQPCR and ERMI to be research tools not intended for public use, does that mean that ERMI samples are useless for mold investigations and remediation work? Not at all. The related science provides another important tool for IAQ and mold professionals, but, just like any powerful tool, ERMI samples can be dangerous to those who do not understand how to use them properly.

The Hazard of Using a Non-Repeatable Sample Collection Process

For many years the EPA Office of Science Policy webpage contained a statement proclaiming, "Anyone, anywhere, if the technique [MSQPCR] is used properly, should get the same identification and quantification for the target mold as anyone else."

A good part of that confidence was based on the fact that the EPA had standardized the sample collection method for ERMI. In the EPA research studies an ERMI sample is collected with a filter device attached to a vacuum. The instructions are very precise, with a composite sample collected from the flooring of the living area and main bedroom of a home. In each location a 3-foot by 6-foot area is marked out and carefully vacuumed for exactly five minutes. All of the EPA's comparison values were based on this process.

Nevertheless, today some licensed laboratories are encouraging their clients to collect ERMI-style samples using a Swiffer-style dust collection cloth. The user is told to wipe a variety of surfaces, such as door jambs and refrigerator tops, until they see a visible accumulation of dust/debris on the cloth. Little, if any, emphasis is place on recording specific locations where the cloth is wiped or carefully measuring the surface area being sampled.

Despite this complete abandonment of the EPA recommended sample collection process, the results are calculated and interpreted as if it were a real ERMI sample. The EPA Office of Inspector General was restrained in their assessment of this problem when their report noted, "If mold samples are not collected in accordance with the sampling procedures used to develop the ERMI, the results would be of questionable value."

The problem is obvious: individuals are collecting samples using one method and comparing the results to a table that was designed for samples collected using a different method. There may be a correlating factor, but no one has validated it yet—especially since the original sample collection method has not yet been validated!

Overall, this does not mean that the results are useless, but it does mean that we must be more cautious when interpreting those results. Quite bluntly, there is ample evidence to suggest that a laboratory is doing a disservice to the industry by encouraging Swiffer-style samples without warning people of some of these difficulties.

Using a Standardized Comparison Formula Designed to Evaluate Long-Term Conditions to Measure Short-Term Results

The more industry professionals study the ERMI process the more questions arise regarding its ability to be a good measure of post-remediation quality for a building. The process uses a weighted logarithmic scale to come up with the two scores: one for mold spores related to water damage (Group 1) and the other for spores typically found out-of-doors (Group 2). The Group 2 score is then subtracted from the Group 1 score to derive the final ERMI value.

The whole process was developed from a review of several thousand houses and was designed to evaluate long-term conditions in the building. Laboratories that analyze ERMI samples put a disclaimer in their reports stating that the results may not accurately reflect recent developments in the structure.

To help illustrate some of these concerns, the table below was compiled from three actual ERMI reports. Rather than looking at individual spore concentrations, the table simply summarizes the numbers for the spores in Group 1 and Group 2. Remember that Group 1 includes some nasty types such as *Stachybotrys*, *Chaetomium*, and *Fusarium*. It should also be noted that high levels of common outdoor spores, such as *Cladosporium* (the primary component of the Group 2 spores), can cause health reactions, as well.

		Building 1	Building 2	Building 3
Group 1	Total spores	35,325	4,933	163
	Log sum	35.88	24.71	8.4
Group 2	Total spores	96,553	11,410	147
	Log sum	34.35	17.84	4.0
ERMI Score	(*Group 1 log sum minus Group 2 log sum*)	1.53	6.87	4.4

The chart clearly shows that the home with the lowest spore concentration in the ambient dust does **not** have the lowest ERMI score. In fact, the home with the highest level of spores by far

ended up with the lowest ERMI score. In short, when measuring post-remediation cleanliness, actual spore concentrations are a better measure of effectiveness than logarithmic sums.

To put it in math terms, look at the difference in raw numbers between the illustrated ERMI scores. The cleaner a remediation contractor gets a home, the more difficult it is to get a low score because they are reducing the denominator of the fraction as well as the numerator.

For Sensitized Individuals it is All About the Level of Allergens

The big question for individuals with sensitivities to mold and other allergens is not an ERMI score, but rather, how clean the environment is that they occupy. Given the numbers in the chart, which house would be better for sensitized individuals to live in? Building 1 has the lowest ERMI score, and actually fits the criteria that some medical professionals are using to guide their patients, which is that a building they inhabit must have an ERMI score less than 2. In the example, Building 3 has a Group 1 spore concentration 200 times less than Building 1, but an ERMI score twice as high. Similarly, the Group 2 concentration of spores in Building 3 is 650 times lower than Building 1's, but that does not really help with the ERMI score. In fact, the low spore concentration in Group 2 works against the remediation contractor because they do not have a bigger number to offset the Group 1 log sum.

The irony of the situation is clear. The cleaner a home is made through remediation, the more difficult it may be to achieve an acceptable ERMI score. The reason the home that might be best for a sensitized person may not have the best ERMI value is because individuals in the mold remediation field do not understand the limitations of this sampling and analytical method for assessing post-remediation activities.

Pushing ERMI Beyond its Original Design

Another real concern with the increasing use of ERMI samples by individuals who are not familiar with the details of the process is that it is clearly being used for projects where there is no indication that the data is even remotely valid. The Environmental Relative Moldiness Index was developed based on a review of mold spore levels in homes. No offices or commercial buildings were included in the original EPA study.

Nevertheless, many inspectors and others in the mold remediation field are collecting ERMI samples from office buildings, schools, and even hospitals. They are using the standard ERMI interpretation guide, broken into quartiles, for buildings where there is no indication that those guidance numbers are appropriate. As stated above, this misapplication is so prevalent that the EPA's Inspector General's Office specifically called it out in their critique of the ERMI the validation process.

Sampler Beware

Someone who has skimmed this entire article may get the impression that the ERMI process (sampling/analysis/interpretation) is so fraught with errors that the tool is not valuable. Nothing could be farther from the truth. ERMI samples and the interpretation guidelines developed by the EPA are valuable tools for professionals in the mold remediation field. Even so, like any powerful tool, they can cause problems if the operator is not knowledgeable and experienced.

The goal of this article is not to discourage the use of ERMI samples, but to encourage their use with proper collection (vacuum methods), analysis (licensed lab), and interpretation (homes, not commercial buildings; general assessment, not post-remediation) procedures. It is the investigator, not the laboratory, who is responsible for developing an appropriate sampling scheme, choosing the right sampling method, and understanding how the data will be interpreted to help resolve a particular situation. As with every other type of sampling available for mold remediation, the individual collecting the samples must be aware of the benefits and limitations of the process and make sure they are choosing the proper method for their specific situation.

About the Author

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