Non-Technical Overview of Chinese Drywall Testing

9-12-09

This article discusses the *commonly* used methods for testing Chinese drywall. We focus on:

- ✓ What the commonly used testing methods are.
- ✓ What questions the methods are attempting to answer and how well they answer them.
- ✓ Limitations of each method.

The methods we will cover are:

Head Space Analysis: Samples of Chinese drywall are removed from walls and ceilings and sent to specialty labs for the purpose of measuring the types of gases and quantity of gases released from the material in a lab environment.

Air Sampling: Air samples are collected in a home or office and then sent to specialty labs for the purpose of determining the types of gases and quantity of gases inside the home or office living/working space.

Visual ID of Copper Corrosion: Technique used to aid in the determination of the extent or presence of Chinese drywall in a building based on a visual assessment of the amount of copper tarnishing (generally) inside wall cavities and inside air handlers.

Odor: This technique attempts to quantify the amount of Chinese drywall odor to aid in determining the presence or absence of Chinese drywall inside a building's living space.

Visual ID of Edge Tape and/or Markings: Drywall can usually be identified when removed from walls by checking the colors and the writing on edge tape and by markings or printing on the drywall.

Microscopic Analysis of Chinese Drywall Indicators: Chinese drywall has a number of differences between US drywall that can be easily and reproducibly distinguished under a microscope. For example, density, amount of reinforcement fibers, color, organic particulate inclusions and other parameters differ between Chinese and US drywall. An inspection technique based on microscopy has been developed by Biostratigraphy.com under contract to our firm that looks at certain physical property indicators in the gypsum core itself which can then be used to differentiate US from Chinese drywall.

Some investigators will attempt to determine if the drywall is problematic Chinese drywall by evaluating the material composition of the drywall.

We will not cover techniques that analyze material composition in this overview as in our minds these techniques are not very useful in identifying problem Chinese drywall due to the very high degree of variability in the chemical makeup of drywall.

Note: We have done our own X-ray diffraction studies comparing the chemical make up of Chinese drywall to US drywall as the basis for these comments. Call for copies of the data.

Because one brand of drywall has a different chemical composition compared to another does NOT make it a problem.

Drywall is *problem* drywall if it off gases or has the potential to off gas problem levels of corrosive gases inside *a home or office environment*.

Not all Chinese drywall meets this description and therefore not all Chinese drywall is problem drywall.

If the most important property is determining if the drywall off gases corrosive and/or unhealthful gases why not simply send drywall samples to the lab to check (called Headspace Analysis) to see if there is elevated sulfur gas emission from the samples?

Head Space Analysis: *Samples of Chinese drywall are removed from walls and ceilings and sent to specialty labs for the purpose of measuring the types of gases and quantity of gases released from the material in a lab environment.*

Drywall samples from known problem homes with known problem drywall *may not* give off corrosive (sulfur) gases in the laboratory environment? Why? Because there needs to be available moisture (humidity) and warm temperature to see this effect. Some labs are cool and dry and samples need to be warmed up and injected with humidity before analysis in order to measure significant levels of off gassing.

For this same reason problem homes have the highest odor problems in the hot/ humid summer months and not in the cooler/ drier winter months. Proper conditions need to be used to see off gassing in the lab environment.

On the flip side of the coin, given a high enough temperature and humidity within the lab testing environment ALL drywall even top quality US drywall will off gas sulfur gas to some extent.

Some synthetic US drywall made from fly ash (does not smell when in a home environment) when tested along side problem Chinese drywall in a lab – under elevated temperature and humidity conditions – can have the exact same measured levels of emissions as the foul smelling Chinese drywall. How is this possible? The test equipment can only read a range of gas levels and under high temperature and humidity both the non-smelly U.S. synthetic drywall and the foul smelling Chinese drywall can read at the instrument max. Thus the 2 samples appear to have the same level of off gassing but this is simply an artifact of the way the testing was performed.

What does all this mean? Head space analysis that results in a positive for sulfur gases always needs to be confirmed by visual inspection of level of copper tarnish or better yet finding the name on the back or edge of the drywall.

Head space analysis does not tell you the levels of gas being breathed by home owners. It can be useful in distinguishing problem Chinese from non-problem Chinese drywall when the testing and data analysis are performed properly.

Head space analysis tells you only that the piece analyzed is CD or not. Not the extent in the home or office.

Air Sampling: *Air samples are collected in a home or office and then sent to specialty labs for the purpose of measuring the types of gases and quantity of gases inside the home or office living/working space.*

From many perspectives this is the ideal form of testing. The current ongoing studies by the FLA DOH focus on air sampling because this is the only method that can provide information as to exposure level of occupants to gas emissions. By knowing the exposure levels, toxicologists can determine the extent (if any) that occupant health can be impacted.

However air sampling can be tricky, and can have a high cost and long turn around time. Air sampling requires a certain amount of training and the right collection containers. It is not for everyone.

There are different *types* of gases to be found in Chinese drywall emissions. The corrosive and smelly gases are believed to be inorganic sulfur compounds such as H2S, COS, and CS2. Studies have shown that there are also a number of organic gases emitted by the problem Chinese drywall as discussed on p 2 of the CPSC Chinese Drywall Report dated July 2009. It is not just the sulfur gases but also emitted organic gases that have the potential to cause health problems in occupants, depending on their levels of course.

These organic gases are easily measured when testing for sulfur gas emissions. I am not sure why the FLA DOH (as I understand it) is not including such gases in their studies but is only focusing on the sulfurs.

There are several collection containers being used to take Chinese drywall air samples. The ones we are familiar with are: Low cost Tedlar bags; Quality Tedlar bags; Quartz lined stainless steel containers (we like the .4 liter size.)

In our hands the low quality Tedlar bags do not work for collecting sulfur gases from Chinese drywall. These are the most commonly used bags and the fact that they are not suitable for air sampling is the reason that hundreds of homes smelling of Chinese drywall have been tested with these bags and measurable levels of gas have not been found.

It is my understanding that the FLA Dept of Health has come to the same conclusion as we have, that is, that the low quality Tedlar bags most commonly used to collect air samples are not suitable for such work. DOH is using the high quality Tedlar bags. We prefer the quartz lined stainless steel containers and have found them best for air sampling sulfur gases and organics.

Air sampling can tell you the levels of gas being breathed by home owners. It can be useful in distinguishing problem Chinese from non-problem Chinese drywall homes when the testing and data analysis are performed properly.

What air sampling cannot ever do is indicate how much Chinese drywall there is. Is there Chinese drywall in the ceiling or 2nd story or just the first story? Or is all the drywall problem Chinese drywall?

Our firm uses air sampling at the conclusion of remediation to prove that there are no detectable Chinese drywall emissions. This is called Post-Remediation Clearance Testing and is heavily used following both mold and asbestos remediation. Firms that never measure elevated levels of gases even in homes that are full of smelly Chinese drywall should not be issuing post-remediation clearance certificates based on testing.

Visual ID of Copper Corrosion: *Technique used to aid in the determination of the extent or presence of Chinese drywall in a building based on a visual assessment of the amount of copper tarnishing (generally) inside wall cavities and inside air handlers.*

Only when the copper is either pitch black or is pristine clean you can safely say (in our experience) if there is problem Chinese drywall or rule it out. However there is very often a middle level of tarnish and in such situations this methodology is not in itself deterministic.

If you have non-smelly drywall that is off gassing a very small amount of corrosive sulfur gas over years there can be some level of copper tarnish inside walls and inside an air handler *without any detectable odor or measurable levels of indoor gas.*

This means that there is NO PROBLEM with this home.

Copper tarnish can also occur as a result of sewage gas leaks; sulfur in water; as well as (it would appear based on some preliminary studies) gypsum-based Gyp-Crete flooring on second floors.

Checking the level of tarnished copper is an important part of any inspection for Chinese drywall but has its limitations and should be used in conjunction with other testing methods unless you have either extreme black tarnishing or clean pristine copper. Based on the pictures we see on the web posted by others, conclusions of problem Chinese drywall based solely on tarnish levels are quite often incorrect.

Odor: *This technique attempts to quantify the amount of Chinese drywall odor to aid in determining the presence or absence of Chinese drywall inside a building's living space. Is there a characteristic Chinese drywall odor or not? If so, how strong is the odor? How about inside a wall cavity if you remove an electrical plate and smell inside the box?*

Detecting odor is one of the best methods (during warm, humid summer months) for identifying problem Chinese drywall. While, in our experience, you do not get false positives with this approach when the odor level is extreme especially when used in conjunction with inspecting copper corrosion, you can certainly find homes without heavy odor levels that are full of problem Chinese drywall. Lack of odor does not in itself guarantee no problem Chinese drywall.

One cannot determine the extent of Chinese drywall in a home solely by the distinctive Chinese drywall odor.

Visual ID of Edge Tape and/or Markings: *Drywall can generally be identified when removed from walls by checking the colors and the writing on edge tape and by markings or printing on the drywall.*

Often times, there is a mix of drywall with not all drywall being problematic. Quite often in a 2 story home each floor has different drywall since the top floor is typically stocked on a different day than the bottom floor. Ceilings often require *UL approved* Fire Code rated drywall and in such cases are always non-problematic drywall even when the walls are problem drywall.

The drywall is 12' long. If you remove the baseboard from a wall that is more than 12 feet long you will find a joint where one sheet starts and another ends. Often you can find part of the edge label to confirm that the drywall is problem drywall. Bring a battery operated nail gun and a few colors of caulking to all inspections to replace the baseboard after you patch the hole. Such an inspection can be done along with the repair in 30-40 minutes.

Microscopic Analysis of Chinese Drywall Indicators (MACDI): *Chinese drywall has a number of differences between US drywall that can be easily and reproducibly distinguished under a microscope.*

For example, density, amount of reinforcement fibers, color, organic particulate inclusions and other parameters differ between Chinese and US drywall. An inspection technique based on microscopy has been developed by Biostratigraphy.com under contract to our firm that looks at certain physical property indicators in the gypsum core itself which can then be used to differentiate US from Chinese drywall.

Please see attached reports on this technique. This technique (MACDI) is not a proprietary technique and can be performed at any lab desiring to make the investments necessary to perform the required analyses.

In our hands, MACDI can reliably tell if the drywall is Chinese or not.

MACDI must be used in conjunction with other techniques to reliably distinguish problem Chinese drywall from non-problem Chinese drywall.

We have tested many homes with this technique. Before we confirm any type of Chinese drywall we pull up a few baseboards and check the edge tapes at the seam joints for confirmation.

MACDI is expensive for a single home.

However, MACDI it very inexpensive for the testing of 5 - 10 homes on a single (1 day) visit – costing between $2500 to $3500 for testing up to 10 homes with up to 35 samples sent to the lab for analysis. Turn around time is typically less than 5 days for lab results and write up.

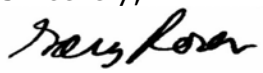
MACDI takes a small piece of drywall from under a wall electrical plate or under an AC supply register in the ceiling for sample analysis. There is absolutely no damage to the walls or ceiling with this approach!

MACDI can reliably and inexpensively determine the mix of Chinese and non-Chinese drywall in home when used in conjunction with odor and copper corrosion assessment.

If MACDI testing concludes Chinese drywall, the conclusion must always be confirmed by removing enough drywall to read the manufacturer name or edge tape color code.

There is no single perfect method for Chinese drywall determination.

Sincerely,



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Analysis and comparison of US and Chinese drywall for the purpose of developing a rapid, low-cost test procedure to distinguish problematic Chinese made drywall

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April 30, 2009

Revised July 28, 2009

Confidential

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April 30, 2009; *revised July 28, 2009*

Analysis and comparison of US and Chinese drywall for the purpose of developing a rapid, low-cost test procedure to distinguish problematic Chinese made drywall

Executive summary:

Six samples of drywall were submitted for the purpose of developing a quick and reliable method of differentiating problematic Chinese made drywall from non-problematic drywall. The following five methods were developed.

1) Statistical measurement of air voids can be used to differentiate between the US and Chinese made samples, but does not differentiate between the Chinese BNBM and the problematic Chinese drywall.

2) Hydrochloric acid test for carbonates (calcite, aragonite and dolomite) can be used to differentiate between drywall with known problems (Chinese made Knauf, White Wrap and Clear Wrap) and drywall with no known problems (US made USG5/8, USG½ and Chinese made BNBM).

3) Oxidizing acid test for pyrite and marcasite (FeS_2) while potentially useful for drywall samples containing higher amounts of FeS_2, none of the samples showed obvious reactions. This test was not useful for distinguishing drywall with known problems.

4) Observing fiber content in crushed drywall has potential to discriminate between the source and quality of the drywall, but needs larger sample sizes and more complicated processing than requested.

5) Observation of organic particles in wet crushed drywall can be used to differentiate between drywall with known problems (Chinese made Knauf, White Wrap and Clear Wrap) and drywall with no known problems (US made USG5/8, USG½ and BNBM).

The results of the analysis of these six samples suggest that the problem drywall can be quickly and inexpensively identified by 1) measurement of air voids, 2) hydrochloric acid test for carbonates, and 3) observation of organic particles in wet crushed drywall. It is recommended that more samples of quality drywall with no known problems from a diversity of manufacturers be submitted to test and increase the statistical reliability of these methods.

Introduction:

Six samples were submitted by Gary Rosen, PhD of Certified Mold and Allergen Free Corporation for the purpose of developing a rapid, low cost test procedure to distinguish problematic Chinese made drywall used in south Florida between 2004 and 2009. The sample submission letter is appended to this report.

Two US manufactured drywall samples and four Chinese manufactured drywall samples were analyzed in an attempt to find criteria that can be used to quickly discriminate between the source and quality of the drywall. Rosen's sample submission letter identifies the sample country of origin and whether the sample drywall has a known problematic history with quality, durability and odor.

USG5/8	US made	No known problems
USG½	US made	No known problems
BNBM	Chinese made	No known problems
Knauf	Chinese made	Known problems
White Wrap	Chinese made	Known problems
Clear Wrap	Chinese made	Known problems

Five simple tests were devised to in an attempt to quickly and inexpensively differentiate between problematic and non-problematic drywall: 1) measurement of air voids, 2) hydrochloric acid test for carbonates, 3) oxidizing acid test for pyrite and marcasite (FeS_2), 4) observation of fiber content, and 5) observation of organic particles in wet crushed drywall.

Any conclusions drawn from this report should consider the small statistical data set. It is recommended that more samples of quality drywall with no known problems from a diversity of manufacturers be submitted to test and increase the statistical reliability of these methods and results.

Results:

1) Statistical measurement of air voids: The rock (non-paper) portion of the drywall contains closely spaced air voids. The mean size and distribution of sizes were measured. The US made drywall has larger mean air void sizes with a more uniform size distribution than the Chinese made drywall. Table 1 presents statistics for air void size distributions. Figure 1 presents histograms and images of pore size distributions for each drywall sample and Figure 2 show close-up images taken at 20X magnification that illustrates the differences between the US and Chinese made drywall. This method can be used to differentiate between the US and Chinese made samples.

2) Hydrochloric acid test for carbonates: Gypsum is the primary component of the white rock core of drywall. Gypsum, $CaSO_4\,2H_2O$, is a naturally occurring mineral formed by the evaporation of sea water or saline lake water. Calcite and aragonite, $CaCO_3$, also occur in within evaporite deposits. Hydrochloric acid (HCl) does not react with gypsum, but reacts vigorously with calcium carbonate ($CaCO_3$). Calcium carbonate most commonly occurs as mineral species of calcite, aragonite or dolomite. These mineral make up limestones and dolomites, which often occur associated with gypsum deposits. The US made samples and the Chinese sample labeled BNBM showed little to no reaction with 30% HCl. Chinese made samples Knauf, White Wrap and Clear Wrap all reacted vigorously with HCL, indicating the presence of calcium carbonate minerals. Table 1 presents the observed reaction intensity. This test can be used to differentiate between drywall with known problems (Chinese made Knauf, White Wrap and Clear Wrap) and drywall with no known problems (US made USG 5/8, USG and BNBM). Calcium carbonate is very easily decomposed by acids. If pyrite is present and decomposing, the resulting sulfuric acid could decompose the calcium carbonate and weaken the drywall rock structure.
Note: To eliminate the possibility that the HCl reaction might be from water soluble sodium bicarbonate, a sample of Knauf was crush, soaked in water, water washed through a 63 µm sieve and tested with HCl. The water washed sample reacted as strongly as the unwashed sample . This further supports that the reaction was due to the presence of calcium carbonate minerals.

3) Oxidizing acid test for pyrite and marcasite: Pyrite and marcasite (FeS_2) are naturally occurring minerals. In sedimentary rocks, these minerals often occur as small (<10 µm) disseminated grains. Pyrite and marcasite are opaque and appear black in transmitted light microscopy. Pyrite and marcasite react vigorously with nitric acid (HNO_3) releasing an orange gas. This provides a quick chemical test for pyrite and marcasite. Small opaque grains were easily observed in the Knauf and White Wrap samples. All samples were tested with concentrated HNO_3 after the HCl exhausted the $CaCO_3$ content. No FeS_2/nitric acid reaction was observed in any of the samples. However, when nitric acid was added to samples before the HCl, the nitric acid reacted with the carbonate minerals in the Chinese made Knauf, White Wrap and Clear Wrap samples. Any possible reaction between small amounts of $FeS_2$and nitric acid would have been masked by the volumetrically larger reaction between the nitric acid and calcium carbonate. This method, while potentially useful for drywall samples containing higher amounts of FeS_2, was not useful for determining the presence of FeS_2 in the drywall with known problems (Chinese made Knauf, White Wrap and Clear Wrap). Table 1 presents the observed reaction intensity.

4) Observing fiber content in crushed drywall: For each sample, approximately 125 mm^3 of clean rock portion of drywall was crushed to approximately 15 µm or smaller particle size. Care was taken to avoid paper or glue on the outer surfaces of rock. Long thin fibers were observed in all samples. It was not possible to accurately quantify the fibers, but qualitatively, the US made drywall appeared to have higher fiber content. The fibers were picked from the crushed drywall and mounted for transmitted polarized light microscopy. Figure 3 shows fibers recovered from each drywall sample. The fibers from all the samples appeared similar, except for the Chinese made Knauf sample. Fiber content may be a contributing factor to drywall durability. Sieving the crushed drywall rock through 10µm mesh screen could isolate and concentrate the fibers providing a means to quantify the fiber content. However, fiber concentration by sieving would require one cubic cm or more of paper-free, glue-free drywall rock material, which is more than the intended sample size for routine testing.

5) Observe organic particles in wet crushed drywall: For each sample, approximately 125 mm^3 of clean rock portion of drywall was crushed to approximately 15 µm or smaller particle size. Care was taken to avoid paper or glue on the outer surfaces of rock. Dark particles were observed, but could not be identified or quantified. Distilled water was added and the crushed drywall and stirred. Some organic particles that were free of adhering minerals floated to the surface of the water. The number of floating particles in one field of view at 20X was counted. The US made samples and the Chinese sample labeled BNBM had relatively low counts: USG 5/8 -3, USG1/2 - 3 and BNBM - 9. The Chinese made Knauf and White Wrap had much higher counts (30 and 29, respectively). The Chinese made Clear Wrap sample also had high counts (20), but the much smaller particle size of this sample may have allowed a greater number of adhering minerals to prevent organic particles from floating. This test can be used to differentiate between drywall with known problems (Chinese made Knauf, White Wrap and Clear Wrap) and drywall with no known problems (US made USG 5/8, USG and BNBM). Floating particles from Knauf and White Wrap were recovered, transferred to a microscope slide and examined in differential interference contrast and polarized illuminations. Figure 4 shows images of the floating particle from the Knauf and White Wrap samples. Some of the organic particles are pellets of heterogeneous amorphous organic matter and small mineral grains. While these pellets appear similar to naturally occurring organic particles found in most marine and lacustrine (lake) sedimentary rocks, it is impossible to exclude other sources.

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Table 1: Drywall test observations

	USG1/2	USG5/8	Knauf	BNBM	WW	CW
Air void statistics						
Ave. void dia. µm	466	456	103	93	114	266
StDev void dia. µm	112	167	94	57	86	310
Min void dia. µm	250	100	25	25	25	25
Max void dia. µm	750	950	500	200	400	1100
Acid test reaction						
HCl reaction	Low	Low	High	Low	High	High
HNO_3 reaction w/ FeS_2	None	None	None	None	None	None
Non-mineral particles						
Floating organics	3	3	30	9	29	20
Fiber content	High	High	Low	Low	Low	Low

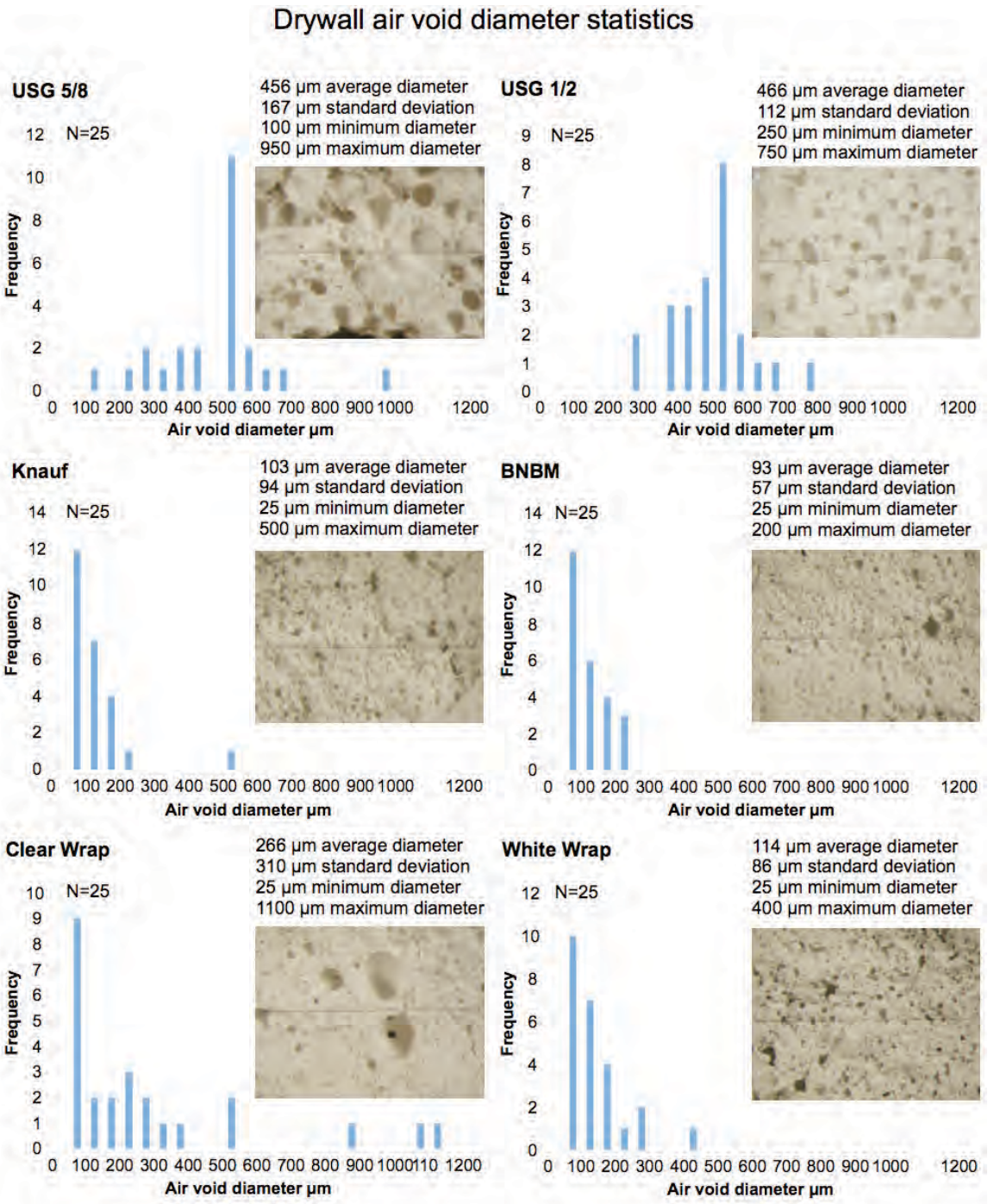

Figure 1: The US made drywall has a larger mean air void size with a more uniform size distribution than the chinese made drywall. This method can be used to differentiate between the US and Chinese made samples. All images taken at 20X and presented at the same final magification.

Drywall air void diameter close-up images

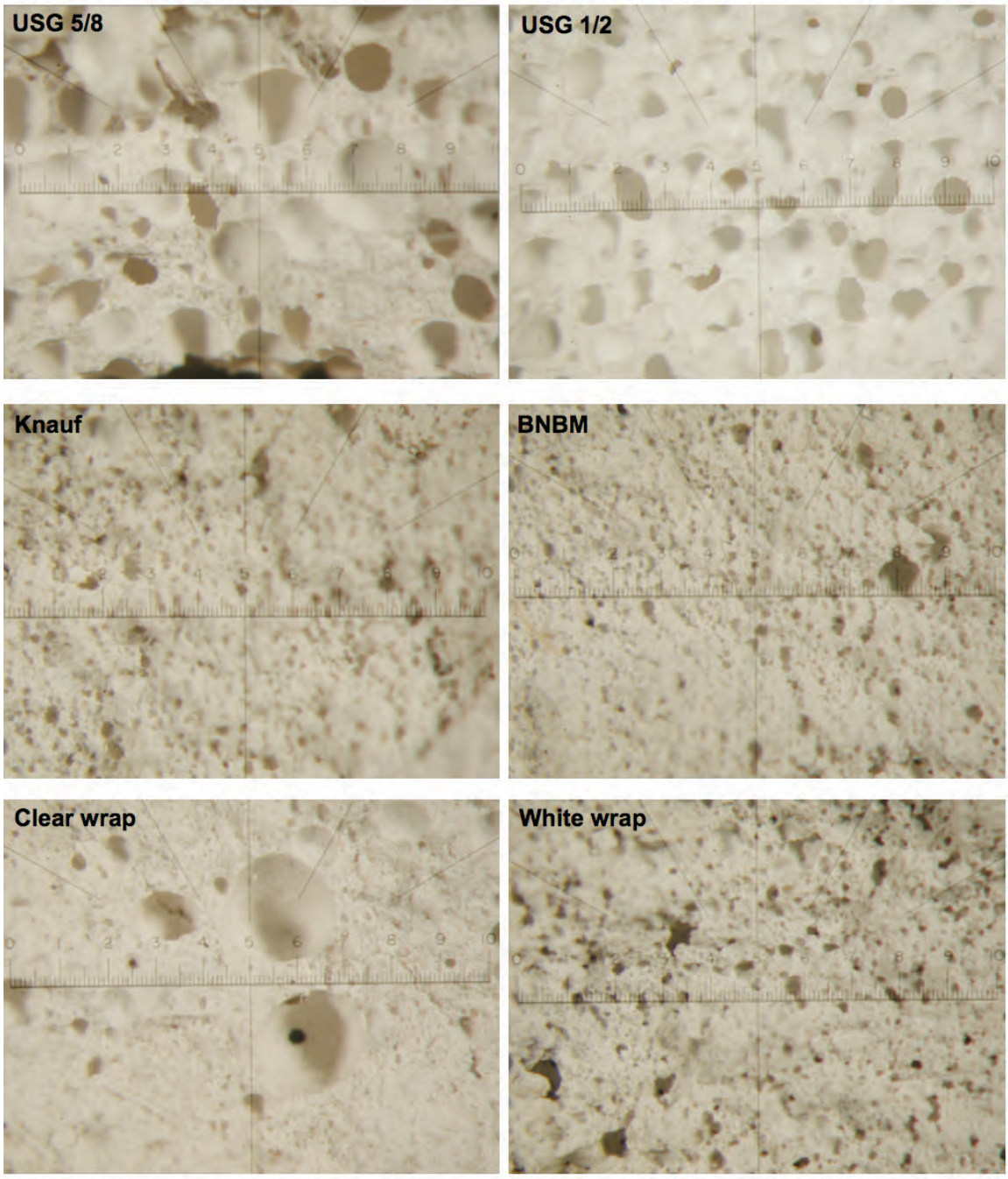

Figure 2: The US made drywall has a larger mean air void size with a more uniform size distribution than the chinese made drywall. This method can be used to differentiate between the US and Chinese made samples. All images taken at 20X and presented at the same final magification.

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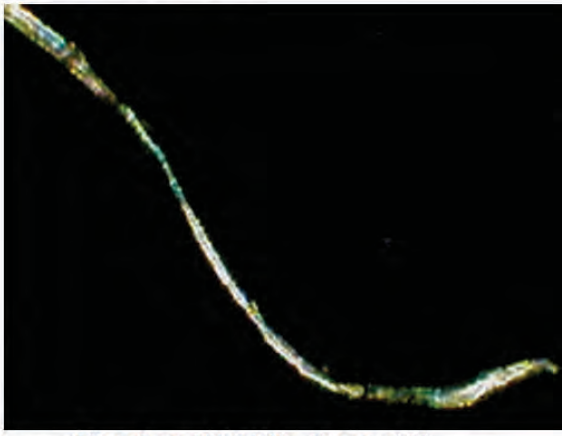
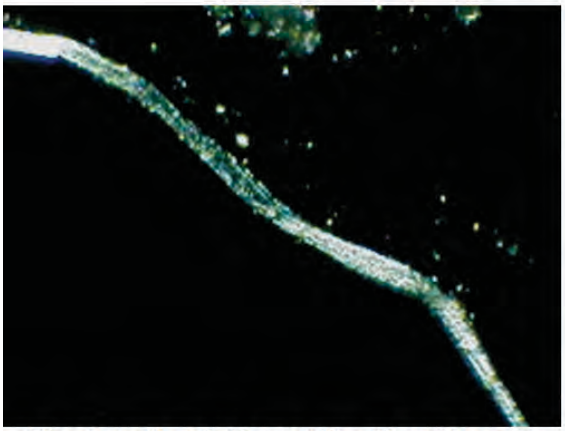
Fibers recovered from drywall samples

Fibers from USG 1/2

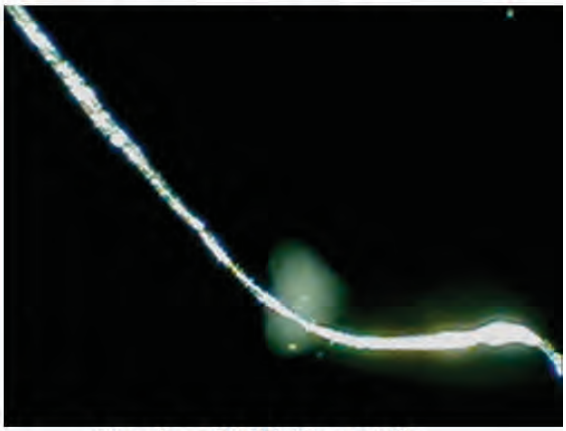


Fiber from USG 5/8 - 15µm width

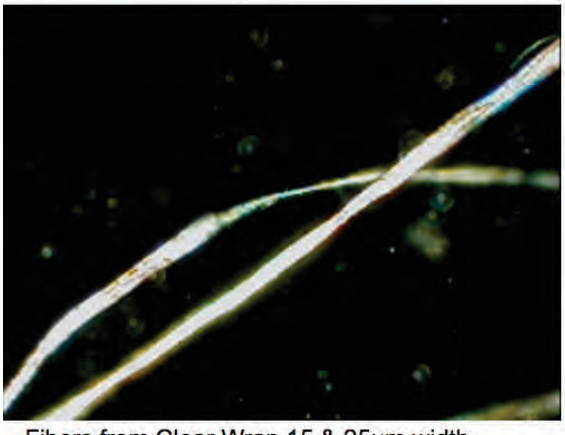
Fibers recovered from crushed drywall were more abundant in the US drywall



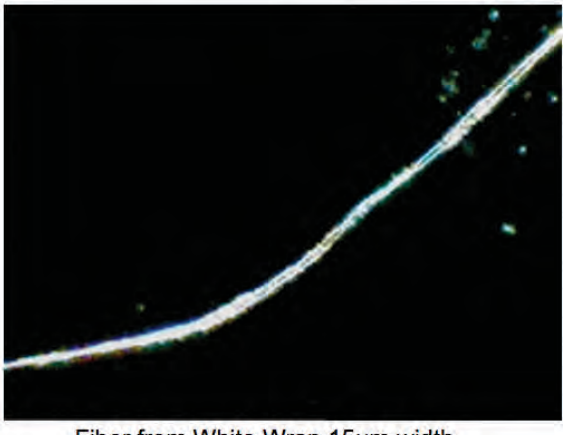
Fiber from Knauf ,43µm width, differed from the others in size and compositiion



Fiber from BNBM 15µm width



Fibers from Clear Wrap 15 & 25µm width



Fiber from White Wrap 15µm width

Figure 3: The US made drywall has a higher fiber content. This method has potential to be used to differentiate between the US and Chinese made samples. Images taken in polarized transmitted light

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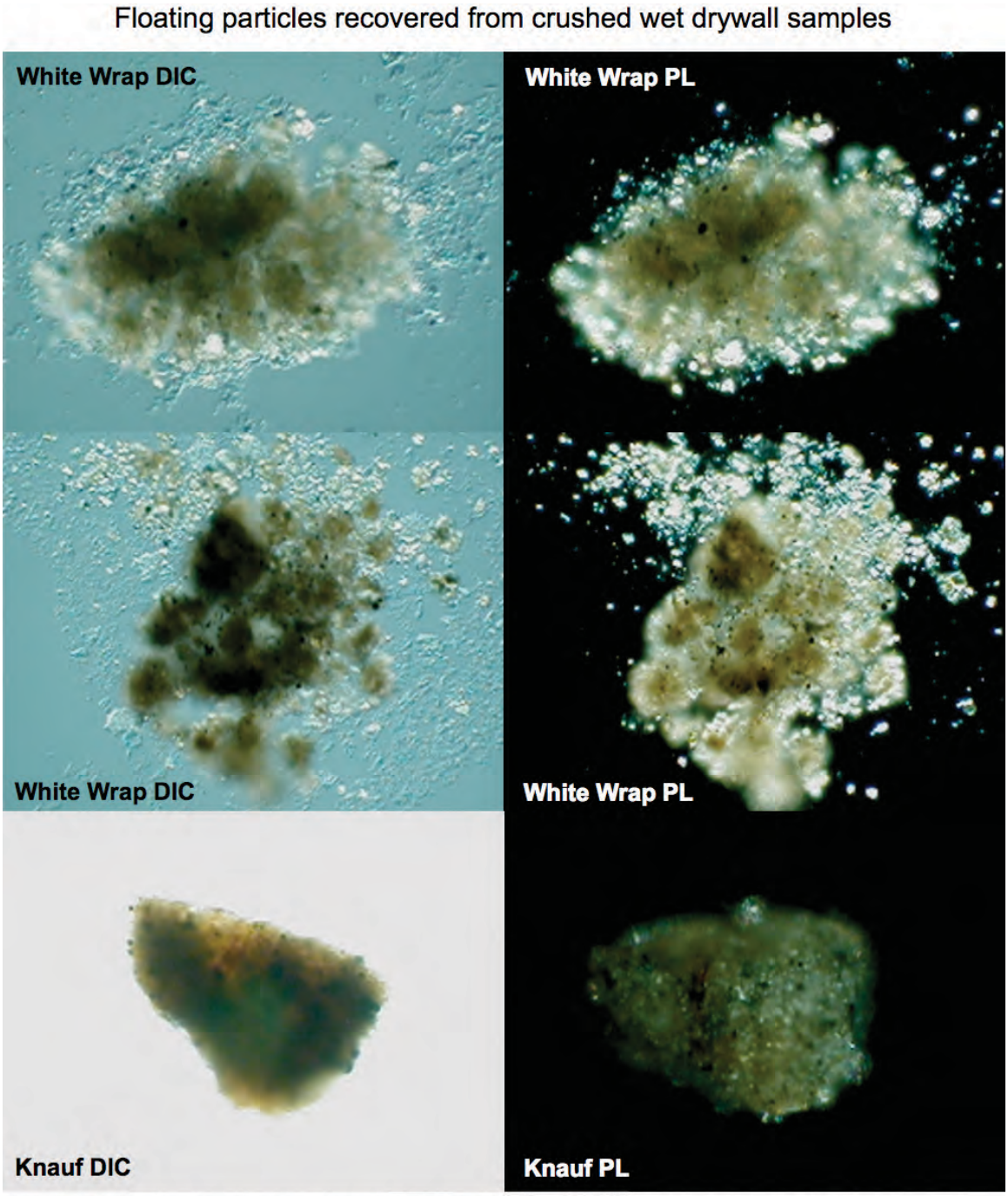


Figure 4: Pellets of heterogeneous amorphous organic matter from the Knauf and White Wrap drywall samples are similar in appearance to aquatic invertebrate fecal pellets. The amorphous organics (brown and dark) are surrounded by minute adhering mineral (gypsum) particles.

Frequently asked questions:

Q. Is the organic material in the problematic Chinese drywall from sewage and therefore full of pathogens.
A. Some of the organic particles are pellets of heterogeneous amorphous organic matter and small mineral grains. While these pellets appear similar to naturally occurring organic particles found in most marine and lacustrine (lake) sedimentary rocks, it is impossible to exclude other sources.

Q. Is the Chinese drywall derived from waste products of phosphate mining such as phosphogypsum? Phosphogypsum refers to the gypsum formed as a by-product of processing phosphate ore into fertilizer with sulfuric acid. Phosphogypsum is radioactive due to the presence of naturally occurring uranium and radium. The concern obviously that if the Chinese drywall is derived from phosphogypsum it would have radioactive elements in it.
A. Test for radioactivity

Q. A similar question. Is the Chinese drywall derived from waste products of coal mining such as fly ash and therefore contaminated with many hazardous materials?
A. Test for radioactivity, Examine thin-sections, XRD, Bulk whole rock geochemistry

Q. Does the Chinese drywall contain radon gas?
A. Test for radioactivity We have not tested for radon but radon is not typically found in such deposits. It is associated with deposits containing uranium and thorium.

Q. Why is the problematic Chinese drywall (apparently) degrading?
A. All three of the problematic Chinese drywall samples tested for this report reacted to hydrochloric acid indicating a significant presence of calcium carbonate. Calcium carbonate [$CaCO_3$] (mineral species calcite and aragonite) and less likely dolomite [$Ca(Mg)CO_3$] commonly occur as layers above, below or within naturally occurring gypsum deposits. Calcium carbonate is very easily decomposed by acids. The problematic Chinese drywall has been shown (by others, see FL State website on this matter) to contain pyrite, which decomposes in humid air releasing sulphuric acid. The resulting sulfuric acid could decompose the calcium carbonate and weaken the drywall rock structure.

Q. Some of the reports indicate that strontium sulfide is present in the problematic Chinese drywall and that it reacts with moist air forming H_2S, which is a source of the rotten egg, smell. Can this report comment on this or any other reason for the source of the rotten egg smell?
A. Decomposition of iron sulfides such as pyrite and marcasite may also produce this odor.

Biostratigraphy.com,LLC		for Certified Mold Free				Project: Chinese Drywall Analysis Inspection 8-1-09				
Samples Taken 8/01/2009						Received: 8/6/2009 Analyzed: 8/8/2009				
Sample #	Bldg/Unit #	Fibers	Reactivity	Dark particles	Edge tape	Air void size distribution	Room	Tarnish	Known Chinese	Odor
1	XXX Bay	Few	Strong	Abundant	n/a	Highly variable 2, more continuous range of sizes 50-750µm	Laundry Room	2		No
2	XXX Bay	Few	Strong	Abundant	n/a	Highly variable 2, more continuous range of sizes 50-750µm	Front BR left	4		No
3	XXX Bay	Few	Strong	Abundant	n/a	Highly variable 2, more continuous range of sizes 50-750µm	Entry left	2		No
4	XXX Bay	Common*	Strong	Abundant	n/a	Highly variable 2, more continuous range of sizes 50-750µm	Outside of laundry	5		No
5	XXX Bay	Few	Moderate	Common	n/a	Primarily very small (<100µm)	LR North wall	2		No
6	XXX Bay	Few	Moderate	Common	n/a	Primarily very small (<100µm)	LR West wall	1&2		No
7	XXX Bay	Few	Strong	Abundant	n/a	y variable 1, discontinuous distribution, mainly very small (<100µm) voids with a few very large	Kit West Wall	3		No
8	XXX Bay	Few	Strong	Abundant	n/a	Primarily very small (<100µm)	Break. W	3		No
9	XXX Bay	Few	Strong	Abundant	n/a	Primarily very small (<100µm)	DR S	3		No
10	XXX Bay	Few	Strong	Abundant	n/a	Highly variable 2, more continuous range of sizes 50-750µm	Rear BR	3		No
11	XXX Bay	Few	Strong	Abundant	n/a	Highly variable 2, more continuous range of sizes 50-750µm	Rear BR Hallway	3		No
12	XXX Bay	Few	Strong	Abundant	n/a	Primarily very small (<100µm)	Rear BR Bath	4		No
13	XXX Bay	Few	Moderate	Common	n/a	Primarily very small (<100µm)	Front BR (up) E	2		No
14	XXX Bay	Common	Strong	Common	n/a	Primarily very small (<100µm)	Front BR (up) N	2		No
15	XXX Bay	Few	Strong	Abundant	n/a	y variable 1, discontinuous distribution, mainly very small (<100µm) voids with a few very large	South BR (up) N	2		No
16	XXX Bay	Rare	Strong	Common	n/a	Primarily very small (<100µm)	Up Hall	3		No
17	XXX Bay	Few	Strong	Common	n/a	Primarily very small (<100µm)	Up Bath	2		No
18	XXX Bay	Few	Strong	Abundant	n/a	Primarily very small (<100µm)	Up Back BR E	3		No
19	XXX Bay	Few	Strong	Abundant	n/a	Primarily very small (<100µm)	Up Back BR W	3		No
20	XXX Bay	Common	None	Rare	n/a	Primarily very small (<100µm)	Up Bath Ceiling		5/8"	No
21	XXX Bay	Few	Strong	Abundant	n/a	Highly variable 2, more continuous range of sizes 50-750µm	Back BR S 1	4		No
22	XXX Bay	Common	Strong	Abundant	n/a	Highly variable 2, more continuous range of sizes 50-750µm	Back BR S 2			No
23	XXX Bay	Few	Strong	Abundant	Y	y variable 1, discontinuous distribution, mainly very small (<100µm) voids with a few very large	Back BR Baseboard			No
24	XXX Bay	Few	Strong	Abundant	Y	y variable 1, discontinuous distribution, mainly very small (<100µm) voids with a few very large	Front BR Baseboard			No
25	XXX Bay	Common	None	Rare	Y	y variable 1, discontinuous distribution, mainly very small (<100µm) voids with a few very large	Garage Attic		5/8"	No

			Stability: Moderate to strong reactions indicate the presence of calcium carbonate, probably in the form of limestone or dolomite				
		Abundant		Abundant= 1 to 3%		Air Voids:	
		Common		Common= 0.5 to <1%		Large ~500µm	
		Rare		Rare= >0 to <0.5%		Highly variable 1, discontinuous distribution, mainly very small (<100µm) voids with a few very large voids	
		Few		None		Highly variable 2, more continuous range of sizes 50-750µm	
		None				Primarily very small (<100µm)	
		*clumped				Very small, dense*, not drywall	
						Tarnish: Level 1 -5 with 5 being black and 1 being shiny copper.	
Procedure:							
The drywall sample was broken so that a clean cross-section could be microscopically examined for air void size distribution & fiber content.							
Drywall material was crushed in a porcelain sample tray and reagent added. The reaction rate was observed and recorded.							
After the reaction ceased the abundance of dark particles was estimated and recorded.							

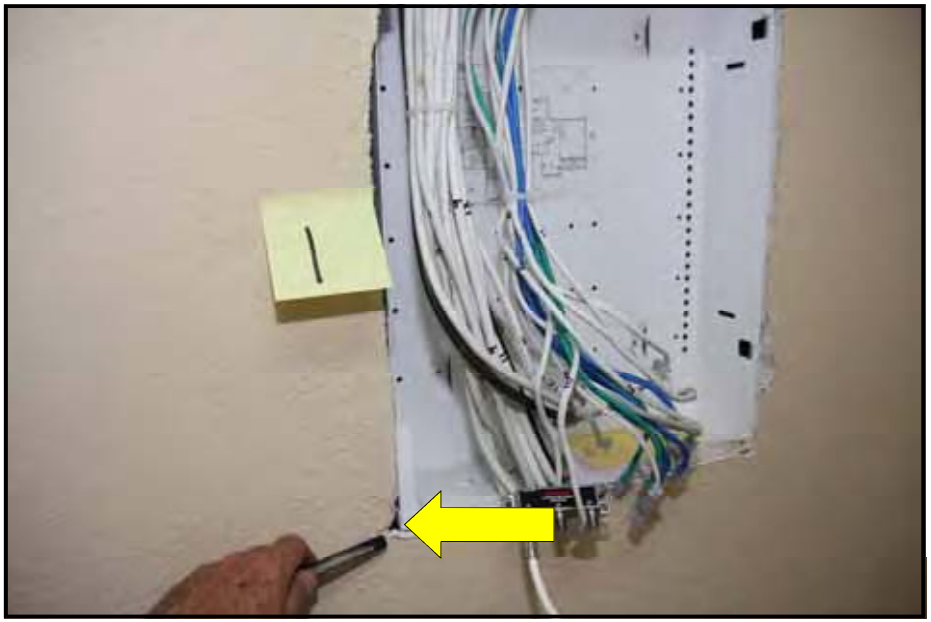
1

Problem Chinese Drywall Inspection
Pictures taken 8-1-09 by Gary Rosen, Ph.D. State Lic. Building Contractor
No known problems/ smells. Investor wanting inspection for resale purposes.
Copper clean here. This AC unit is upstairs inside the home.

2

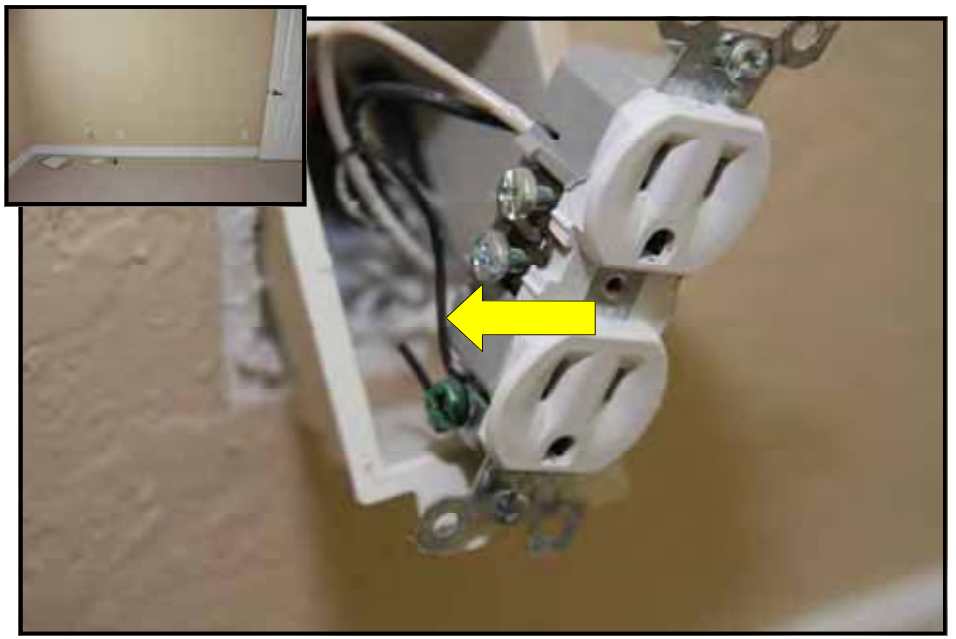
Copper clean outside. Tarnished coils inside. This again is the upstairs AC unit. The downstairs unit is in the garage and not accessible.

3



Took sample #1 from here. The first 12 samples were taken downstairs. We only need a small chip of the drywall for our analysis.

4

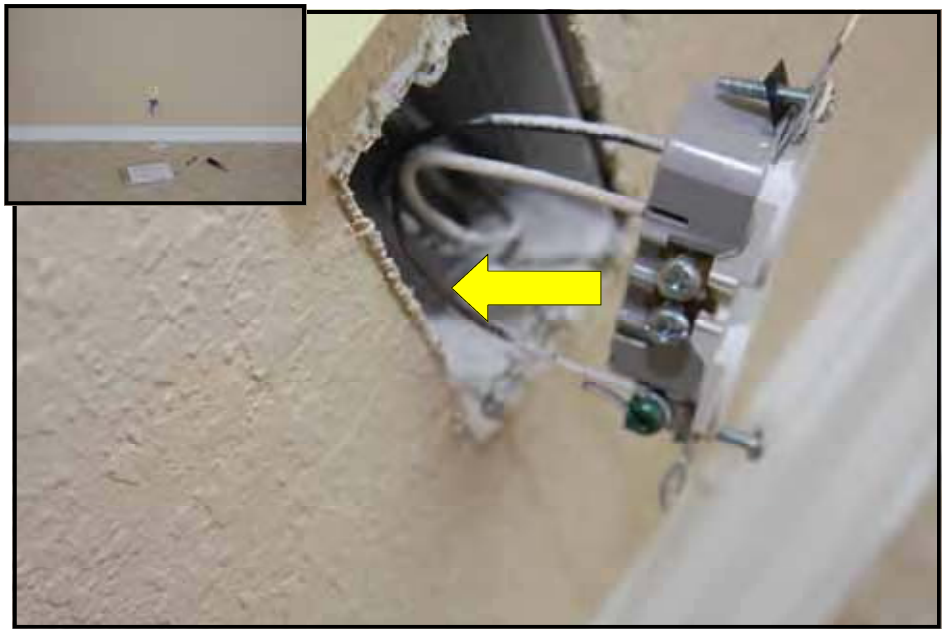


Took sample #2 from here. Arrow points to black copper ground wire. We take a small drywall sample from the electrical outlet . We take a picture of the copper ground wire. And then close it back up. We leave no holes for our analysis.

5

Water damage underneath that could contribute to tarnished copper.

6



Took sample #3 from here. Arrow points to tarnished copper ground wire.

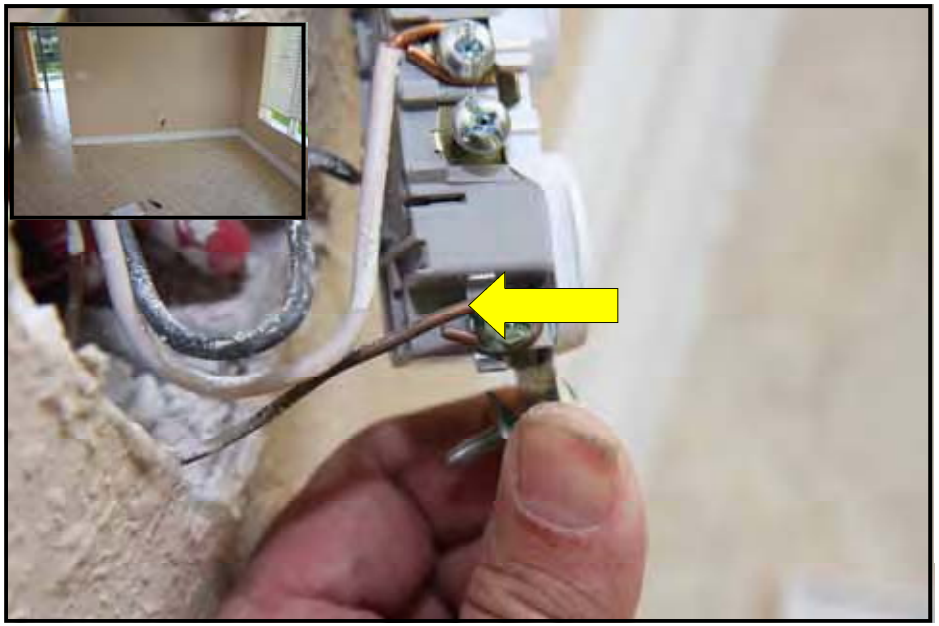
7

Took sample #4 from here. Copper ground wire is black. Behind this wall is the laundry room.
This was the only truly black ground wire in the home. #2, #12, and #21 were almost as dark but not black.

8

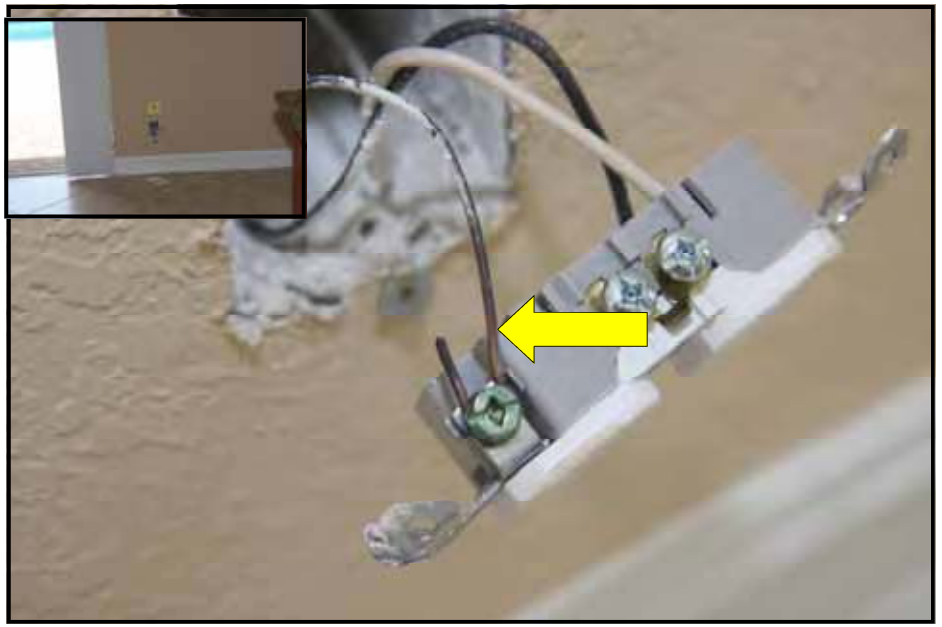
Took sample #5 from here. Copper ground wire is tarnished.

9



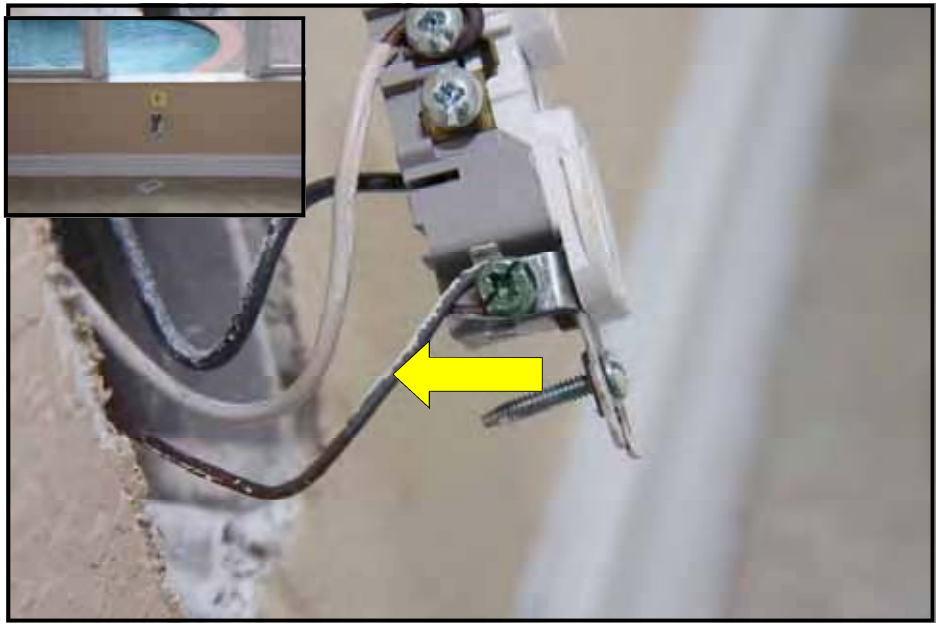
Took sample #6 from here. Copper ground wire is barely tarnished.

10



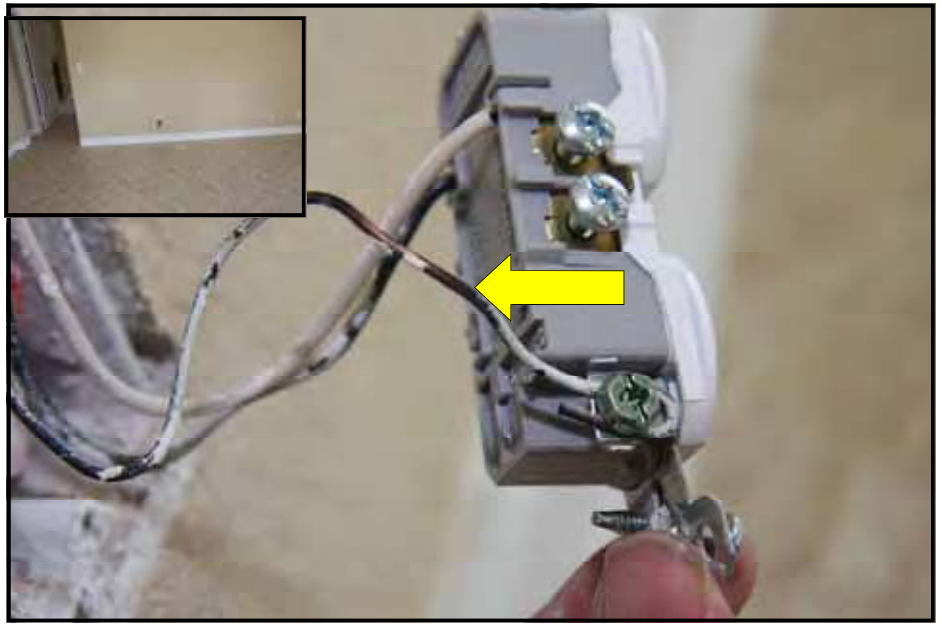
Took sample #7 from here. Copper ground wire is tarnished.

11



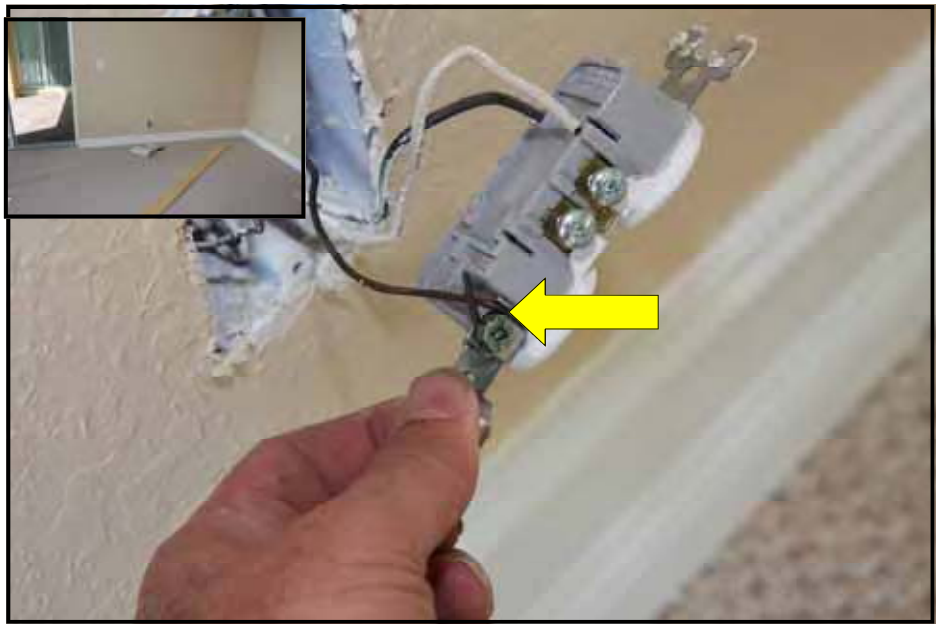
Took sample #8 from here. Copper ground wire is tarnished.

12



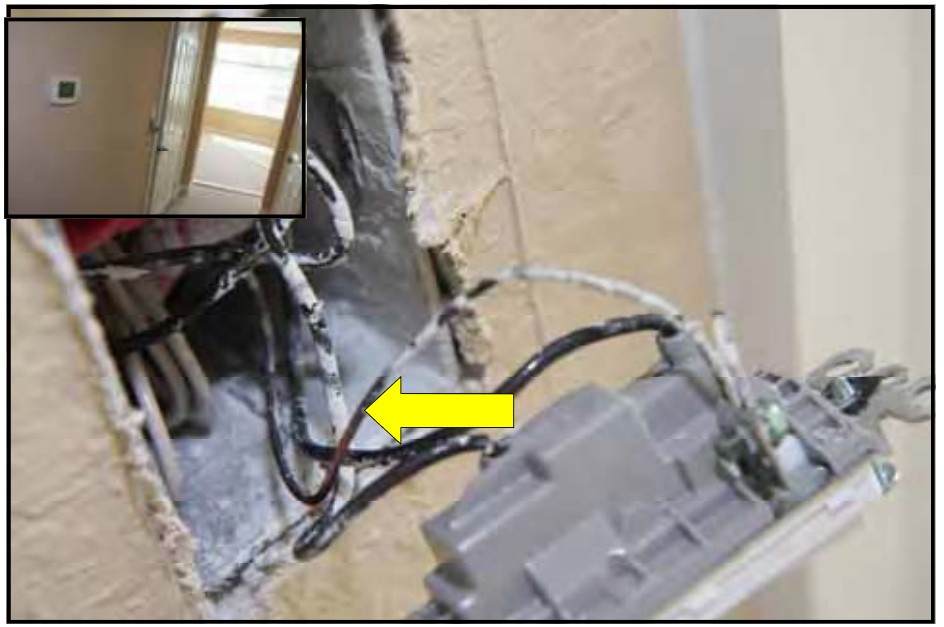
Took sample #9 from here. Copper ground wire is tarnished.

13



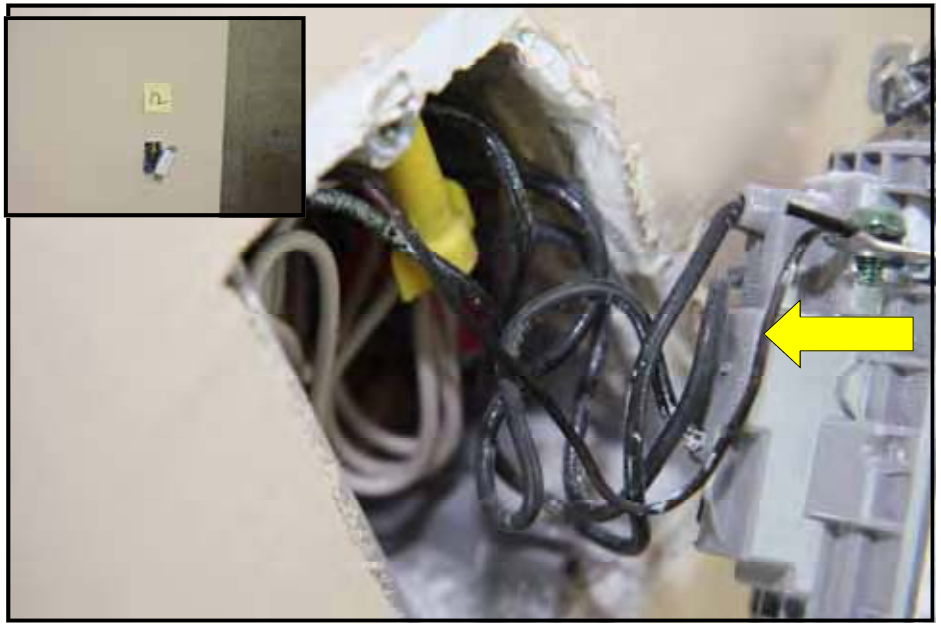
Took sample #10 from here. Copper ground wire is tarnished.

14



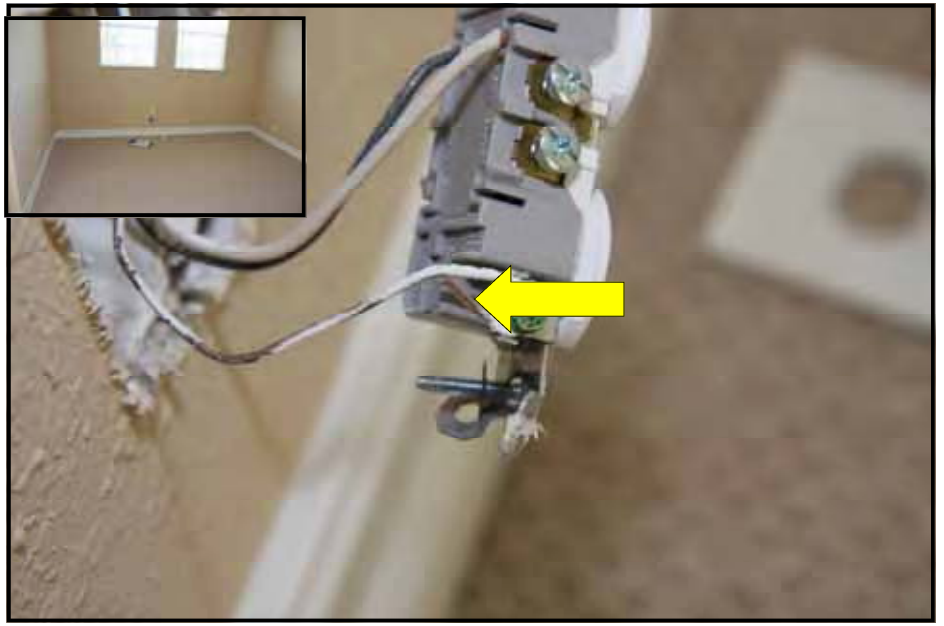
Took sample #11 from here. Copper ground wire is tarnished.

15



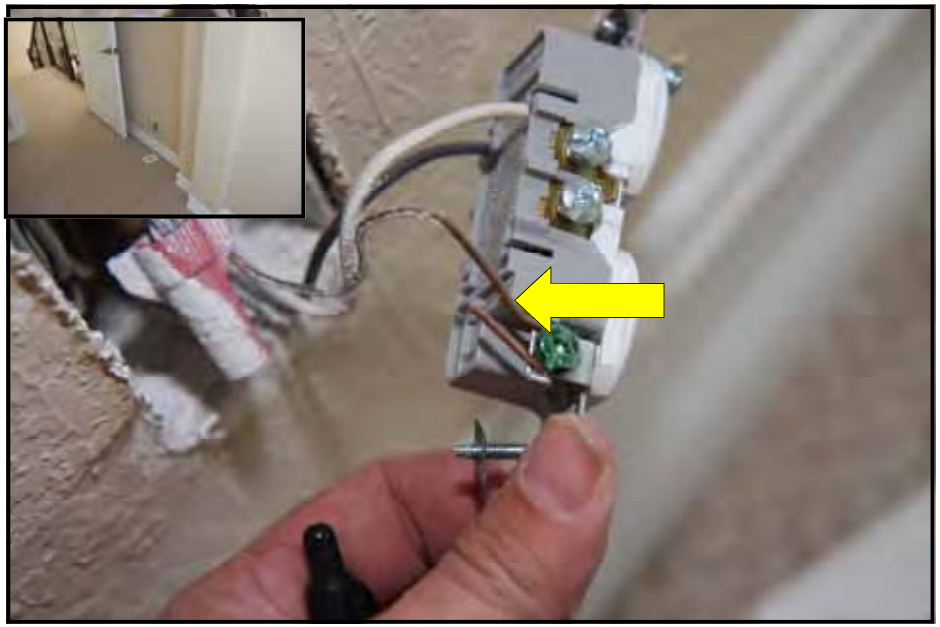
Took sample #12 from here. Copper ground wire is tarnished.

16



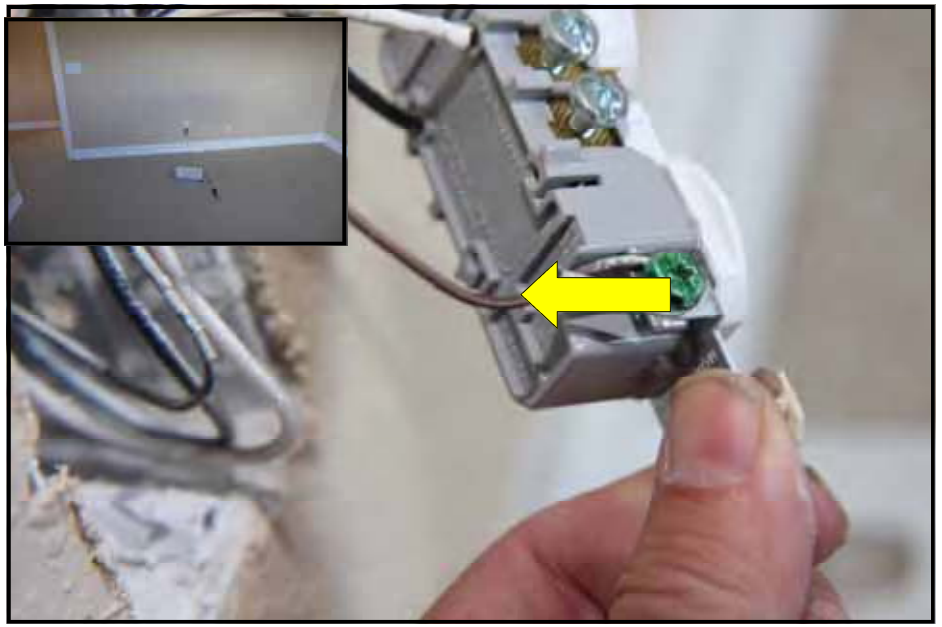
Took sample #13 from here. Copper ground wire is slightly tarnished. (We are now upstairs.)

17



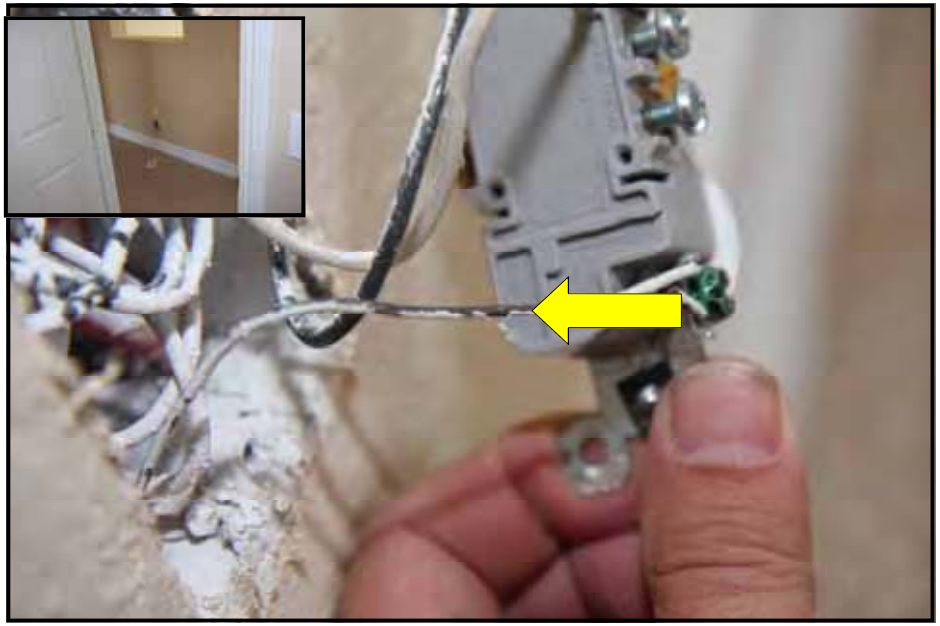
Took sample #14 from here. Copper ground wire is not tarnished.

18



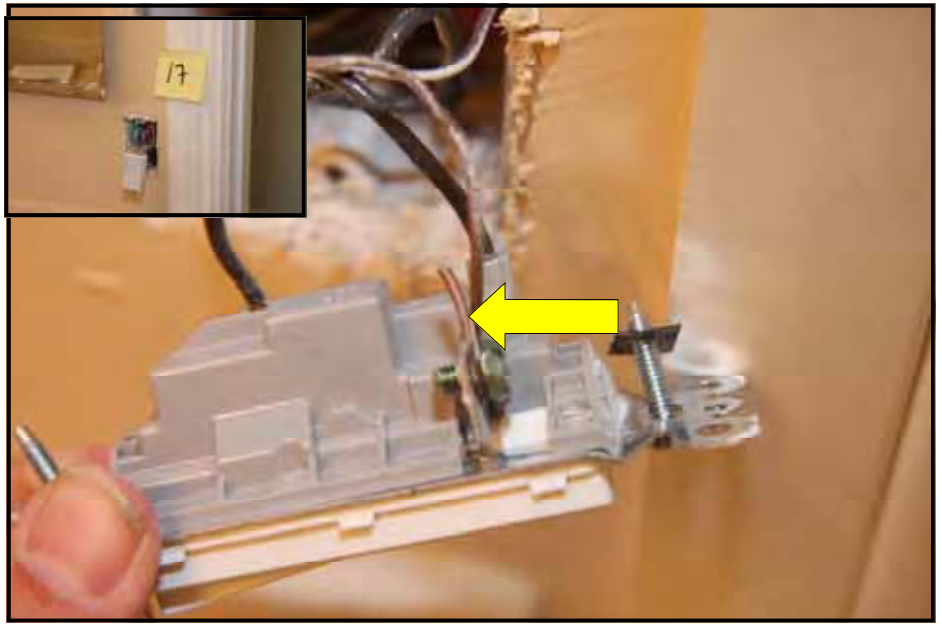
Took sample #15 from here. Copper ground wire is slightly tarnished.

19



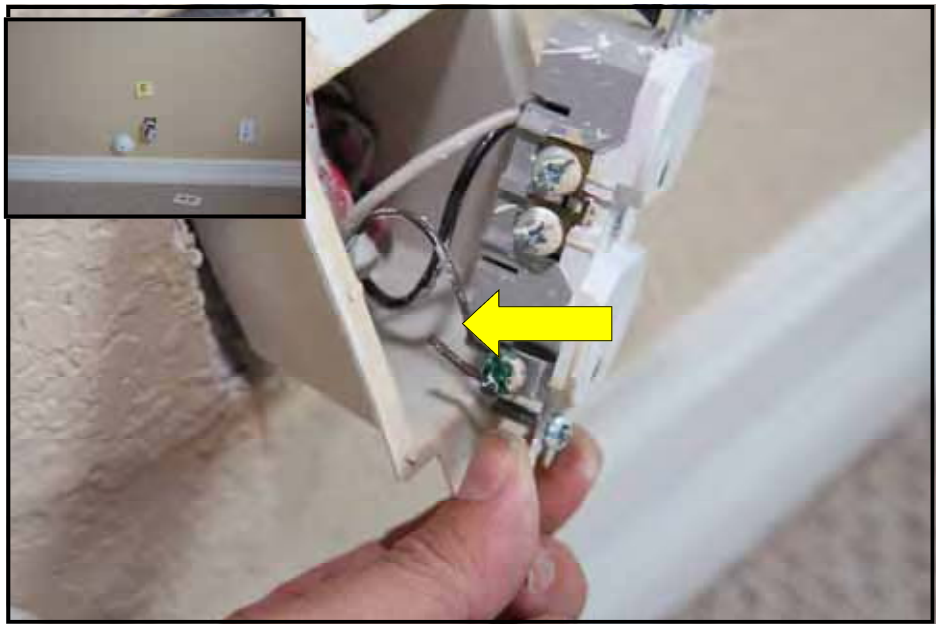
Took sample #16 from here. Copper ground wire is tarnished.

20



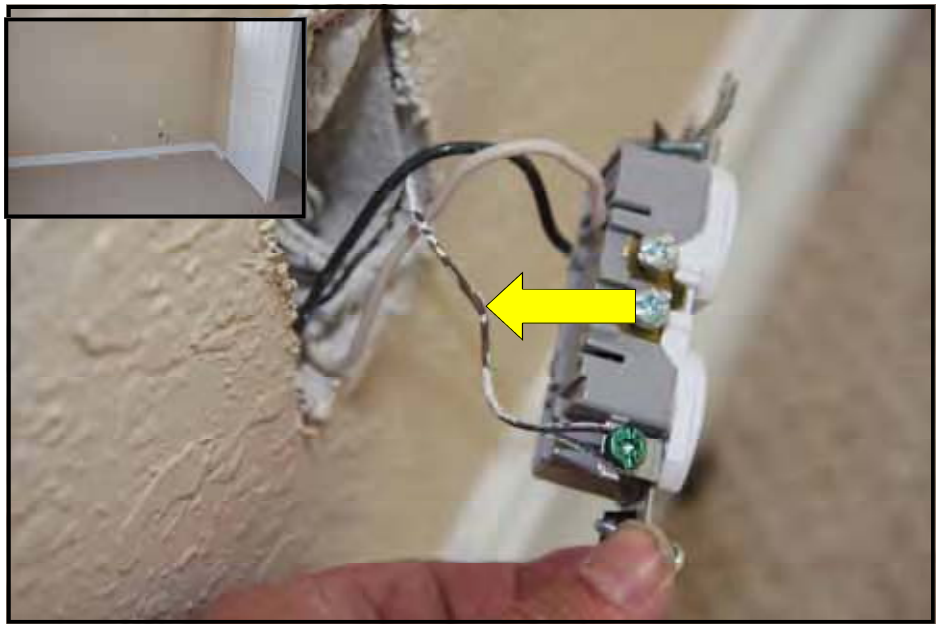
Took sample #17 from here. Copper ground wire is not tarnished.

21



Took sample #18 from here. Copper ground wire is slightly tarnished.

22

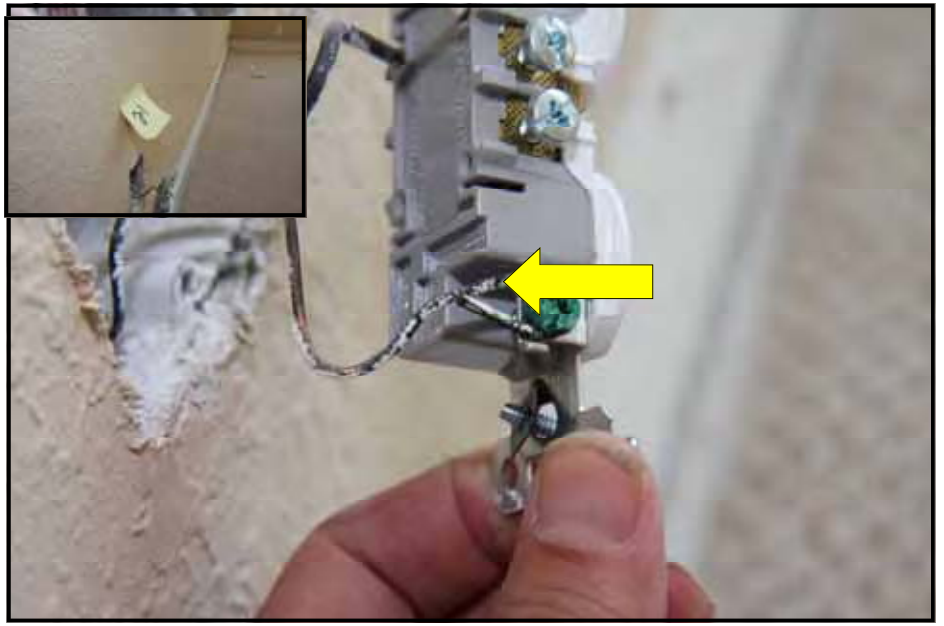


Took sample #19 from here. Copper ground wire is tarnished.

23

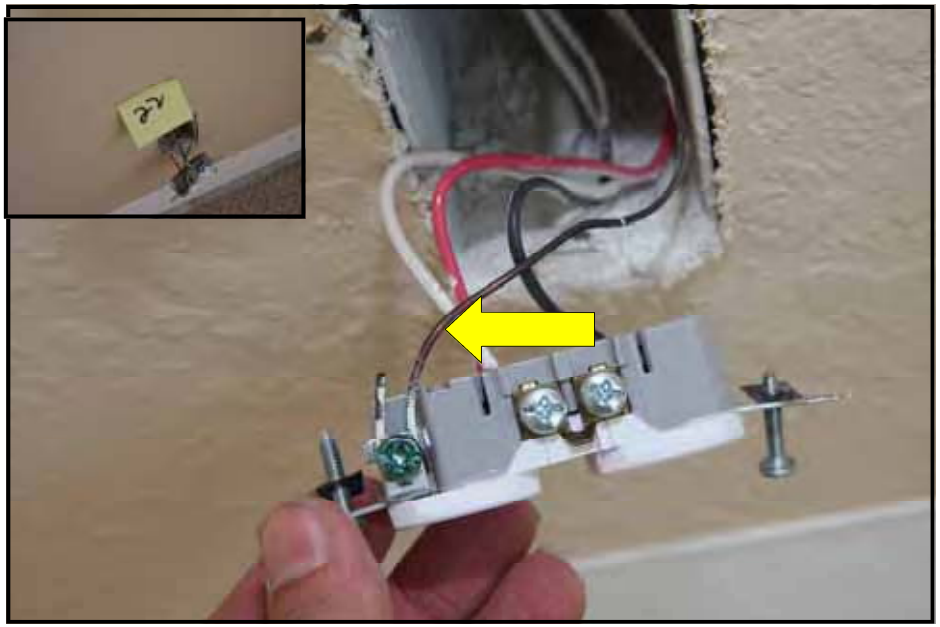
Took sample #20 from ceiling. Looks like 5/8" material which would not be problem Chinese dry-wall.

24



Took sample #21 from here. Copper ground wire is tarnished.

25



Took sample #22 from here. Copper ground wire is tarnished.

26

Took sample #23 from here behind baseboard. Yellow arrow points to edge tape with blue coloring. Many types of drywall have blue coloring including Knauf and BNBM. Not a large enough sample to make a definite determination from the edge tape.

27

Sample #24 Removed drywall from behind baseboard to check edge tape for drywall ID. Yellow arrow points to edge tape with blue coloring. Many types of drywall have blue coloring including Knauf and BNBM. Not a large enough sample to make a definite determination from the edge tape.

28

Checked attic. Took small sample of 5/8" material here. Not Chinese drywall.