U.S. Consumer Product Safety Commission Staff
Summary of Contractor's Evaluation of Homes Reported to be
Constructed with Domestic Drywall[1]
April 15, 2011

BACKGROUND

The U.S. Consumer Product Safety Commission (CPSC) contracted with Environmental Health & Engineering, Inc. (EH&E) to conduct an investigation of a few homes where consumers have reported health and corrosion problems and where they also reported that the homes were built with what they identified as non-Chinese manufactured drywall (often referred to as "domestic drywall" by consumers). Although these reports alleging problems due to non-Chinese drywall represent a very small fraction of the total reported incidents, the CPSC investigated them as part of its overall investigation to gain a comprehensive understanding of the reported problems.

Earlier investigations conducted by EH&E under contract with the CPSC identified a link between problem drywall in a home and increased levels of hydrogen sulfide in indoor air and increased rates of copper and silver corrosion. They also found that orthorhombic sulfur (S_8)[2] was a useful marker for identifying problematic drywall (EH&E, 2010a and 2010b). These findings, in part, formed the basis of the Federal Interagency Task Force on Drywall's Interim Guidance for Identification of Homes with Corrosion from Problem Drywall (CPSC/HUD, 2010).[3]

This guidance includes two steps: (1) a threshold inspection of the home to identify blackening of copper electrical wiring and/or air conditioning evaporator coils and the installation of drywall in the time period of concern; and (2) the verification of corroborating evidence. In accordance with the Identification Guidance, either two or four pieces of corroborating evidence are required to identify a home as one with corrosion from problem drywall. Homes built or renovated between 2001 and 2004 require at least four pieces of corroborating evidence, and homes built or renovated between 2005 and 2009 require at least two pieces of corroborating evidence.

Corroborating evidence can be: the detection of elevated S_8 levels in samples of drywall taken from the home; corrosive conditions; the formation of copper sulfide on copper coupons placed in the homes for 14 to 30 days; visual observation of markings, indicating the origin of the drywall; elevated levels of specific sulfide compounds from chamber testing of drywall samples; or corrosion of copper metal coupons to form copper sulfide when exposed in a chamber with drywall samples.

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[1] This document was prepared by CPSC staff and has not been reviewed or approved by, and may not necessarily reflect the views of, the Commission.
[2] Also referred to as "elemental sulfur."
[3] Recent investigations indicate that the years should be expanded to include 2009. This has been reflected in an update of the Identification Guidance, March 18, 2011.

STUDY DESIGN

CPSC staff contracted with EH&E to perform this study to assess whether the objective criteria reportedly associated with problem imported drywall and outlined in the field-based component of the Identification Guidance were present in complaint homes allegedly constructed of domestic drywall. CPSC staff also wanted to compare the data collected from these homes with results obtained in the initial, large-scale investigation of homes with problem drywall (referred to as the "51-Home Study"). This comparison is important because the 51-Home Study was the largest study, to date, conducted on problem drywall homes using consistent and rigorous testing parameters. Testing performed as a part of the present study was conducted with methods identical to the 51-Home Study to ensure comparability. In this way, the results of the present study on 11 homes could be placed in context with the results of the larger study. CPSC staff asked that EH&E:

- characterize the indoor environment in consumer complaint homes that were reported to the CPSC to be constructed with domestic drywall, and

- compare the drywall composition, indoor air quality, and corrosion conditions in these homes to corresponding parameters observed and measured in residences in the 51-Home Study.

This study, like the earlier 51-Home Study (EH&E, 2010a) was intentionally designed to identify source characteristics of drywall and characterize the indoor environment in the home where the complaint was reported. Thus, the study was conducted as a field study at the home, and chamber emissions testing and chamber-based corrosion testing were not performed as part of the suite of tests.

CPSC staff selected 11 homes for the study. Homeowners self-reported that their homes were constructed with domestically produced drywall; and before undertaking this study, CPSC staff performed in-depth investigations to remove homes from the study where Chinese markings were clearly present. CPSC staff selected the homes, located in Florida (n=9), North Carolina (n=1), and Pennsylvania (n=1), from drywall-related consumer incident reports that the CPSC received between December 2008 and April 2010. Staff developed a ranking system to guide the current study, which like the 51-Home Study, considered location, date of construction or restoration, severity and extent of reported health effects, and corrosion. Staff also considered consumer-reported manufacturer of drywall as a factor in the home selection, as well as consumer willingness to participate in the study.

Between September 20, 2010 and September 29, 2010, EH&E field teams visited the homes and scanned multiple locations on the walls in each home with an x-ray fluorescence (XRF) analyzer as a screening tool to aid in detecting possible markers of problem drywall; collected drywall samples to analyze for orthorhombic sulfur; inspected ground wires and air handling units for corrosion; conducted air exchange, temperature, and humidity measurements; deployed passive air samplers for measuring indoor air concentrations of hydrogen sulfide and formaldehyde; placed strips of copper and silver metal called corrosion classification coupons in the homes to

measure the rates and types of metal corrosion; and analyzed water samples to rule out alternate sources of sulfides in the homes. The full report can be found on www.drywallresponse.gov. Key results are detailed below and presented in Table 6.2 of the full report, which is attached to this summary.

KEY RESULTS

- Nine of the 11 homes (Homes A–E and H–K) had evidence of blackening of copper wiring or cooling coils and were constructed/renovated in the relevant date range (2001–2009). However, homes investigated to date, impacted by problem drywall, meet a common set of parameters, not all of which were observed in each of the nine homes.

- Five of the 11 homes (Homes A–E) met the criteria for identification of homes with problem drywall in accordance with the Identification Guidance, including elevated rates of corrosion and elevated concentrations of S_8 in drywall samples. Hydrogen sulfide was detected in the air in only three of the five homes (Homes A, B, and D) at levels that were similar to those levels found in problem drywall homes in the 51-Home Study.

- In five homes (Homes A–E), indoor corrosion rates exceeded outdoor corrosion rates by as much as nine times. These results are consistent with the results found in the 51-Home Study.

- The presence and percentage of drywall samples with source markers (S_8 and strontium/carbonate) in Homes A–E varied by room.

- Two of the 11 homes (Homes F and G) do not have the characteristics of homes with problem drywall consistent with the characteristics found in the 51-Home Study or in accordance with the guidance for identifying problem drywall homes.

- Four of the homes (Homes H–K) had a corrosive environment based on elevated rates of corrosion, as determined by the visual observation rating system and mixed findings of corrosion on the copper and silver coupons between and within each home. The S_8 marker was not found in the drywall samples from any of these four homes.

- In four homes (Homes H–K), outdoor corrosion rates were sometimes similar to the indoor rates.

- All of the homes in this study had air exchange rates that are typical of North American residences.

- Formaldehyde levels in the 11 homes were consistent with levels found in recently constructed homes and results of the 51-Home Study and were not associated with the drywall.

- Sulfides were not detected in any water samples from any of the 11 homes and, therefore, were not likely a potential contributing factor to measured indoor corrosion rates.

- Average humidity and temperature conditions in the 11 homes were typically within the ranges recommended for summer months by the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE). The temperature and humidity levels were generally higher in homes in Florida in comparison to the two homes (Homes F and G) located in North Carolina and Pennsylvania.

OTHER ISSUES AND STUDY LIMITATIONS

- Information that these homes were constructed solely with domestically manufactured drywall as opposed to Chinese drywall was obtained by self-report from the occupants. CPSC staff and EH&E were not able to confirm independently that all of the drywall in the homes was produced domestically. This would have required extensive removal of the drywall and destructive testing of the residences.

- An elevated rate of corrosion in homes is not sufficient, by itself, to conclude that the corrosion is associated with problem drywall in the home. Outdoor corrosion rates may be the source of indoor corrosion in some of these homes (Homes H–K). Or, the corrosion source might originate from something other than the drywall.

- In its report, EH&E suggested that additional chamber emissions and chamber-based corrosion studies may help identify whether the drywall is the source of corrosion versus some other factor or source inside or outside of five of the subject homes (Homes H–K). While CPSC staff understands the reasoning for the recommendation of additional study, the CPSC has determined that due to the relatively limited number of homes affected, the uncertainty concerning the drywall's origins, agency resource constraints, and that any findings of problem drywall would not change the current Task Force recommendations, it cannot authorize further expenditure or study on this issue at this time.

- While a sufficient number of drywall samples from each home were analyzed for elemental sulfur (S_8), and the selection of samples to analyze was based on the presence of a secondary marker (strontium) to increase the likelihood of selecting a sample with elevated elemental sulfur, it is possible that, even with the robust study design, problem drywall with elemental sulfur exists on a small number of boards in Homes H–K; however, it was not detected.

- There is a possibility that some problem drywall, including domestic drywall, may have different characteristics from the originally defined problem drywall. For example, there may be differing mechanisms of chemical off-gassing or compositions of source materials; or S_8 might be a good marker for a particular type of problem drywall (for example, problematic Chinese drywall) but not all problem drywall. If that is the case, this study would not have been able to identify this drywall as problematic because it had materially different characteristics from the problem drywall studied to date.

CONCLUSIONS

Based on the characterization of the drywall and indoor environments of the 11 homes tested, comparison of the results with existing data from homes classified as problem drywall homes (51-Home Study), evaluation of the test results in relation to the Identification Guidance, and EH&E's extensive experience in conducting investigations of problem drywall homes, EH&E reported that five of the homes in the study (Homes A–E) have drywall that is consistent with problem drywall. However, because EH&E was unable to confirm independently that all of the drywall in the homes was pr**o**duced domestically, and without detailed documentation of the drywall's origin, or without damaging the homes through extensive removal of the homes' drywall, it is not possible to conclude that only domestic drywall is present throughout the homes.

Four of the homes (Homes H–K) had a corrosive indoor environment, but the test results were not consistent with previous findings related to the identification of problem drywall. It appears that the indoor corrosive environment might be influenced by outdoor corrosive conditions. Based on this study, other indoor sources, or the presence of a limited amount of problem drywall, cannot be ruled out as a source of the indoor corrosive environment. Conclusions regarding the potential of domestic drywall to be problematic cannot be confirmed at this time without further extensive investigation and detailed documentation of the origin of the drywall in these homes.

REFERENCES

EH&E, 2010a. *Final Report on an Indoor Environmental Quality Assessment of Residences Containing Chinese Drywall.*

EH&E, 2010b. *Identification of Problematic Drywall: Source Markers and Detection Methods.*

Table 6.2 Environmental Test Results for Each Home, by Location

Step		Criteria	Home A	Home B	Home C	Home D	Home E	Home F	Home G	Home H	Home I	Home J	Home K
1	(a)	Blackening of copper?											
		-- AND --											
	(b)	Drywall installed 2001–2009?											
2	(a)	S_8 Marker?											
	(b)	Copper Sulfide on coupons?											
	(c)	Markings of Chinese origin?	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF
	(d)	H_2S, COS, CS_2 in chamber test?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	(e)	Copper Sulfide in chamber test?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Other Factors	(a)	Silver Sulfide on Coupons?											
	(b)	Strontium/Carbonate Marker?											
	(c)	H_2S in Indoor Air?											

S_8 elemental sulfur
NF not found in the limited areas accessible for visual inspection
H_2S hydrogen sulfide
COS carbonyl sulfide
CS_2 carbon disulfide
NA not applicable

meets or exceeds the decision criteria
meets or exceeds the decision criteria; potentially impacted by outdoor sources

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