

## Chinese Drywall

*A Greenfield Advisors White Paper*

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*The Chinese Drywall issue is rapidly unfolding, and Greenfield Advisors has been tracking the issues since they first came to light. The following is based on the best information available to date, which is believed to be reliable*

In 2005, a spike in housing construction appeared in the southeastern United States as a result of major hurricanes in the previous year. Coupled with the booming housing market, this led to a shortage of raw material including drywall. To cope with this demand, non-standard sources of drywall were sought out (much of the normal US drywall allotment comes from Canada and Mexico). Knauf International GmbH fulfilled this demand to a large extent by manufacturing and importing drywall from China, to the tune of 500 million pounds in 2006, up from less than 2 million pounds imported in 2005. By 2007 an easing of the housing boom reduced these imports to 33 million pounds, although that is still enough to affect thousands of homes.

The Chinese drywall was made using fly ash, the residue from coal-burning power plants. Fly ash contains many dangerous compounds (chromium, lead and arsenic among others). So far, the only reported impact on human health has been attributed to the sulfur-based gas that the drywall emits. This gas also corrodes (oxidizes and pits) copper building components. Initially this corrosive and caustic gas was thought to be sulfur-dioxide, but it has since been determined to be mostly carbon disulphide, carbonyl sulfide and strontium sulfide.<sup>1</sup>

As homes from 2006 began to age a bit, those built with this Chinese drywall began to manifest problems, notably rotten egg (sulfur) smells and corroding copper plumbing, copper heat exchanger coils, and exposed copper wiring. Scores of lawsuits have cropped up as people noticed the pattern and came to the conclusion that the Chinese drywall was contaminated and defective.

The extent of the problem spans many states. At least two major home builders (Ryland and Lennar) have attempted to remediate the problem by replacing the sheetrock and the more obviously corroded components in customers' homes.

The purpose of this paper is to raise the awareness among real estate professionals about this issue and to provide them with tools to help them identify homes with this faulty drywall. It also provides some background on how some forms of impairment can cause losses in value above the cost to cure, which is referred to as 'stigma' in the real estate lexicon. The paper also outlines some of the valuation techniques that can be used to determine how defective drywall impacts value.

At this time, new information regarding Chinese-made drywall is still being discovered. This paper summarizes the information that we know so far.

## Builder Reactions

Some builders who installed the defective drywall have opted to remove it, at their own cost. They have chosen this route with the expectation that removal of the offending product would alleviate the source of contention for homeowners. Implicit in this action is that it is good for customer relations, it removes the source of the problem, and it closes the controversy without incurring additional expense. The replacement of damaged copper components is apparently being determined on a case-by-case basis. The status of copper components will vary depending upon the environment and duration of exposure to the gases from the drywall. Some homeowners have reportedly replaced the copper in heat exchangers three times already.

## Health Concerns

The defective drywall emits a rotten-egg, sulfur-based smell. Unlike gypsum-based drywall from Mexico and Canada, China manufactures drywall from fly ash residue, a waste material captured from the chimneys of coal-fired power plants. When exposed to moisture and/or heat the off-gassing of sulfur-based gasses has led to reports of increased asthma attacks, coughing, dizziness, fatigue, headaches, irritated eyes, nausea, sinus problems, and sneezing. Epidemiological studies are months from being completed.

The Department of Health (DoH) in Florida has recently reported that the levels of toxins present in these homes do not rise to unsafe levels. This, however, is based on industrial standards rather than residential, and assumes only eight hours of exposure in five out of seven days per week, which is not analogous to a more likely residential situation of exposure for as much as 16 hours or more every day. The question of health effects therefore remains unresolved at present.

## Appraisal Issues

### Detection

Appraisers may be aware of the defective drywall and should consult with their clients about how this issue should be handled. Red flags to appraisers include the brand of drywall used in the home, the location of construction, the date of construction, and a noticeable sulfur smell.

### Brands

Knauf Plasterboard, a German brand owned by Knauf International GmbH, imported Chinese-manufactured drywall through its subsidiary Knauf Plasterboard, Tianjin Co. There is a concern that Knauf also supplied "private label" drywall to retailers to re-sell as their own product, making tracking more difficult. However, to date evidence of this happening is circumstantial and only one claimant has non-Knauf drywall.

### Locations where used

Chinese-manufactured drywall has reportedly been installed in homes in Alabama, Arizona, California, Florida, Louisiana, Mississippi, Nevada, New Jersey, Ohio, Texas, Virginia, Washington, Wisconsin, and Wyoming. Drywall problems not explicitly linking Chinese manufacture have also been reported in Colorado, Georgia, Maryland, Nevada, New Jersey, North Carolina, South Carolina, and Texas. "America's Watchdog" claims it has found defective drywall in 41 states, but suits have not been filed that widely so far.

### Time period

Originally said to date back to 2005, Knauf is now acknowledging that shipments of the Chinese drywall were imported as far back as 2001. Chicago-based USG reportedly imported 9400 tons of similar drywall into South Carolina in April of 2006; exact locations where it was used are unclear. The primary dates and area of

concern at the moment remain 2004-2008 in Florida, when an estimated 60% of all the drywall in question entered the market.

## Visual Clues

Several visual clues may be used to detect Chinese drywall. A/C coils within walls can corrode in as little as four years, and electrical wiring may turn black. Cook top elements will corrode and copper plumbing and air conditioning coils corrode in just a few years. While many companies are now marketing "test kits," the State of Florida considers these generally to be ineffective and recommends a visual inspection. Even a casual inspection by a homeowner may be sufficient, as the "KNAUF" branding isn't difficult to spot anywhere that drywall is exposed; for example, in the attic behind insulation.

## Odors

The most obvious red flag for appraisers is the sulfur smell. However, the smell can be contained by encapsulating paint or masked. If the wallboard has been replaced, the smell will not be noticeable. Excessive corrosion of metal construction components that came in contact with the sulfur-based gas may or may not be visible.

## Laboratory testing

Non-destructive testing seems to be falling short. EMSL labs have not been particularly successful with air samples as the gases measure in the parts per billion in open spaces. Corrosion scrapings (the oxidation and black film) work somewhat better.

Destructive testing seems to work best. Dr. Edward A. Sobeck, PhD of AssuredBio.com the University of Tennessee and Irving Kraut, an industrial hygienist from Naples Florida have developed a process using Fourier Transformed Infrared technology to detect the difference between American and Chinese drywall from a 2"x2" sample.

To compound the problem, some homes were built or rebuilt with a combination of Chinese and American drywall.

## Remediation

Because the extent and long-term effects of the problem are still being discovered, a certain cure is still yet undefined. As in many impairment cases, a total cure may prove infeasible if the value added by the cure is less than its cost.

The most expedient action is to replace the defective drywall with good drywall. This eliminates the emission of the sulfur-based gas and removes the smell. It stops the progression of deterioration of metal construction components that come in contact with the sulfur-based gasses. However, even after replacement of the drywall, there may be substantial residual effects from the drywall. The sulfur-based gases have sped the corrosion of metal construction components such as pipes, electrical components and metal wall studs, thus shortening the economic life of these components.

Accordingly, replacement of the drywall may not effect a total cure. Residual effects might be classified as incurable physical deterioration.

Obviously excessively corroded components could be replaced with new components. However, essentially all the known cases of use of this drywall are in houses less than eight years old. Replacement of plumbing in nearly-new houses may not be feasible if the copper components can still provide years of service. Certainly metal studs, as are used in commercial construction, present a larger concern.

If the effects of corrosion could be gauged with certainty, they might have the same effect on value as-if the builder had installed used piping instead of new piping when building the house. If the effects could be known to be curable (now or later) with certainty, they would

probably not generate stigma. However, we are still learning about the effects of defective drywall.

## Stigma

In real estate appraisal, stigma is term used to describe loss in market value over and above the cost of remediation. When present, it stems from reduced marketability of the property or loss of use and enjoyment. Stigma is also linked to fear or uncertainty about the remediation.

Not every defect results in stigma. Stigma generally does not accompany a defect where the cure is easily ascertained by market participants, totally curable and readily quantifiable. A good example is a furnace that stopped working in the summer time. Market participants would simply consider the cost of replacing the furnace into their pricing decision – once replaced the property would not suffer any residual value loss.

On the other hand stigma may be generated by defects in properties where the cure is not known to be absolute, where the timing of the cure is uncertain, where there may be residual effects even after the cure, where there may be adverse health effects, etc. Examples are properties that have been contaminated or buildings into which water periodically intrudes, is not controllable, and mold results.

In the case of defective drywall, some of the unknowns are how the gases of installed drywall may affect one's health in the short term and in the long term and how much sooner will metal construction components require replacement. Further study is required to determine how these and other unknowns impact the marketability and values of affected properties. If there is a further diminution in value in excess of the cost of an immediately feasible cure, this can be identified as stigma.

For purposes of this discussion, we will use the word remediation in lieu of "an immediately feasible cure".

## Side issues

While not strictly the domain of real estate appraisers, lawyers will find interest in other claims for damages. These damage claims may fall under the headings of health, additional loss in use and enjoyment, and punitive damages.

Further study may find that the drywall has impacted the health of the occupants. This can result in claims for the cost of medical treatments and monitoring. Claimants may also seek damages for pain and suffering.

People who live in houses with defective drywall may suffer a loss of use and enjoyment over and above that which is captured in the stigma losses. The statutes and court findings relative to loss of use and enjoyment vary from state to state. For example, Maryland notes that "A plaintiff who occupies a home is not limited to the recovery of the diminished rental value of it, but may be compensated for any actual inconvenience and physical discomfort which materially affected the comfortable and healthful enjoyment and occupancy of his home."<sup>2</sup> Use and enjoyment may be a separate issue from loss in value.

## Detecting stigma

How can you tell if a property suffers from stigma? Note: these tell-tale signs are taken from Greenfield Advisors' experience in working with contaminated and otherwise stigmatized properties. They are presented, not because these effects have been observed in properties with defective drywall, but to alert the reader to tell-tale signs that, if present, indicate that stigma may be present.

1. Longer marketing periods. Stigmatized properties may sit on the market longer than comparable unimpaired properties. Some may simply be unmarked-

able, in which case rather than a "market value," the property may have some "value in use." Be on the lookout for extended marketing times for properties that have defective drywall or that have had defective drywall replaced. Extended marketing times can result in lost opportunities and increased holding or marketing costs.

2. If an owner of a stigmatized house wants to sell it and acquire a replacement home, but must sell the stigmatized house in order to be able to close on a replacement home, they may not be able to convince a seller of a potential replacement homes to extend the closing while they market the stigmatized home. If the seller of a stigmatized home has to hold it for an extended period of time after having moved out, the excess cost of holding is measurable.
3. The cost of marketing stigmatized properties can be significantly greater. One real estate broker we know charges a consulting fee for assisting property owners through the process of preparing a contaminated property for sale. This broker works with environmental consultants to identify the extent of contamination and to develop, and sometimes implement, a remediation plan that can be evaluated by the state. All this is done before a property is ever listed.
4. Institutional controls. Stigmatized properties may be subject to additional governmental controls. While we are unaware of any institutional controls being added for properties with defective drywall, we have observed them in other contaminated properties. For example, a brownfield property that has been remediated by capping

contaminated soil with a layer of uncontaminated soil requires approval from the state before excavating below the cap.

5. Lower prices. Stigma may result in lower prices for impaired properties. To be attributed to stigma, this loss in value must be greater than the cost of remediation or must persist after the remediation has been completed. For example, homes with asbestos insulation or siding may have restrictions on remodeling or on use of the attic.
6. Disclosure requirements. To date disclosure has not been mandated by any state, however many realtor associations are moving on this of their own accord. In Sarasota, for example, a disclosure form relating specifically to Chinese-manufactured drywall has been introduced.

## Measuring Effects of Stigma

Given the large body of literature on the topic of stigma, this paper will simply provide a brief primer. (See [www.GreenfieldAdvisors.com](http://www.GreenfieldAdvisors.com) for additional reading and information about stigma.)

Generally, stigma is measured is by comparing the loss in value from an unimpaired state to an impaired state to detect the total loss in value. A further deduction for the cost to remediate (i.e., effect a feasible cure) is included to yield the loss in value attributable to stigma. Residual stigma can be calculated as the change in value between an impaired property and the same property after remediation has been implemented. In these kinds of appraisals, it is useful to consider how the results of the findings will be applied. This leads the way that the research and analysis program is designed.

Traditionally, the loss in value is calculated as a percentage of an unimpaired value before

allocating between remediation and stigma. This loss in value becomes, in effect, an adjustment and can be quantified using methods used to extract any other appraisal adjustment.

### **Stigma adjustment extraction**

The process of calculating starts with identifying transactional data for impaired properties. This language is purposefully inclusive as it applies to both sale and lease transactions and to both residential and non-residential properties. Because of its predominance in the domain of Chinese drywall impairment, we will continue this example with residential properties and explore the how stigma may impact the value of the fee simple interest in these properties.

Any methodology which attempts to extract stigma losses from sales prices critically depends on the details of the underlying transactions. For example, buyers (or sellers) are not well aware of the problem, or not fully appreciative of the long-term impact, the sales price will not reflect an actual arms-length transaction.

### **Matched pairs**

When analyzing a small collection of impaired comparable sales, the percentage loss in value may be directly measured using matched pair methodology. This methodology will result in a set of pairs that can be analyzed for differences based upon the circumstances of this impairment. From this set, the appraiser can exercise judgment to determine where, within the range of value loss experienced by the set of pairs, the circumstances of the immediate appraisal indicated that the loss in value for the subject property should lie.

For this methodology to be successful, it is important to find sales of impaired properties that bracket the impairment of the subject property and that are as comparable as possible to the subject property. If appraising multiple

heterogeneous subject properties, multiple sets of paired sales may be required.

When the number of subject properties becomes large, some sort of expert system or valuation matrix will need to be used.

### **Mass appraisal methodology**

When analyzing many impaired properties, mass appraisal methodology such as expert systems, hedonic modeling, or hybrid comparable selection and hedonic modeling systems can be used. These same methods can be used to extract adjustments. When using regression analysis, a factor is statistically derived for each variable being modeled. Statistics relative to the calculation of each factor are calculated in the regression output results. The analyst can then determine if an adjustment is statistically significant or not.

Another way that the percent loss in value of an impairment can be captured can occur using a few modeling techniques.

1. The model can be built using sales of unimpaired properties and then used to calculate the unimpaired values of impaired properties. When so used, the difference between the calculated value and the actual sales price is the loss in value.
2. The model can be built using a "dummy" variable that indicates whether a property is or is not impaired. The contents of this field in the data would be zero or one, with zero representing no and one representing yes. The regression equation output presents a coefficient for this variable along with statistics that allow the analyst to determine if the variable is statistically significant. This methodology yields a dollar amount when the dependent variable (price) is expressed as a dollar amount and really only suitable when the

subject properties and the data used to build the model are homogenous. When the regression equation uses the natural logarithm of the price instead of the dollar amount, the resultant coefficient for the dummy variable is the percentage loss in value attributable to this characteristic.<sup>3</sup>

3. The model may also be built using a series of categorical dummy variables, each expressing different defined levels of impairment. For example one variable might mean slightly impaired, another might mean typical impairment, and the last might mean severe impairment. These terms would have to be appropriately defined during the data collection and input phase of the analysis.

All three of these methods produce estimates of the loss in value attributable to the impairment. They also produce a model that can be used to value the subject properties in an unimpaired state. The advantage of mass appraisal methodology is that the model can be tested for accuracy, which is an important component that goes to the admissibility of evidence in a court case.

Because of the rarity and subtleties in lease transactions and sale transactions of non-residential properties, the data should be carefully evaluated before using a mass appraisal model in these circumstances.

## Summary

Chinese drywall has impurities in it that are not found in American drywall. While the heat and humidity of Florida and other southern states enhance the effects of the sulfur-based gasses, there is no reason to believe these problems do not effect both residential and commercial properties in other parts of the United States.

In addition to a rotten-egg smell, people living in homes with Chinese drywall report respiratory and other health issues. Epidemiological studies are months from being completed. In the meanwhile doctors are advising families with extreme reactions to move out of their homes.

Some large homebuilders are relocating households (people and belongings) while they replace the sheetrock and possibly damaged copper components. Smaller homebuilders are going bankrupt. Insurance Companies are denying claims.

People who find they can't sell their homes (due to the condition and disclosure requirements) and can't afford to live elsewhere are stuck living in an unhealthy environment while weighing walking away from their homes and ruining their credit ratings.

Bank-owned properties are being sold "as-is" with the seller claiming no knowledge on the presence of Chinese Drywall . This systematic lack of knowledge further impairs the handling of the problem.

At present, there are no US requirements for drywall composition. The CDC and HUD are working on a standard for drywall. The Florida Board of Health and Attorney General's office are hard at work on the human issues.

The largest questions are who is going to pay to remediate these homes and what long term health issues might surface? Ads paid for by attorneys anxious for law suits against insurance companies, builders, suppliers, and

others are flooding the media. Some classes are being formed for class actions.

With so many people unable to afford to remediate or to move, one researcher is proposing a system that treats the air to reduce adverse health and corrosion effects. He likens this process to treating the symptoms and slowing the progression of a presently incurable disease while waiting for the cure.

Greenfield Advisors is one of the leading appraisal firms in the nation for valuation of impaired properties. We are gathering data relative to Chinese drywall from valuation professionals and will be publishing our findings just as soon as sufficient data can be analyzed. Greenfield Advisors can be reached at 206-623-2935.

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Greenfield Advisors was founded in Seattle in 1976 to provide high-level analysis and consulting services on complex real estate problems, with a focus on economic, market, and valuation studies. Over the years, Greenfield has advised attorneys, investors, government agencies, trusts, and university endowments on a variety of real estate problems.

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<sup>1</sup> Irving Kraut, consulting Environmental Director; JVI-REO

<sup>2</sup> See *Gorman v. Sabo*, 210 Md. 155, 162-163 (1956)

<sup>3</sup> Technically a small adjustment must be made to this factor to calculate the actual percentage, but the magnitude of the adjustment is akin to a rounding difference. Most appraisers would find this adjustment to be trivial.