CRITICAL ANALYSIS OF DAVIS/ MOON 2015 PRESENTATION ON PARTICLE BOARD CABINET THICKNESS SWELL

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Peer Reviewers. Reviewers Of Our Critique of Moon 2015

- Jared Rosen, University of Florida: B.S. Chemistry; MS International Business; MS Material Science; NAERMC Certified Mold Hygienist. (Author's son.)
- Joseph H. Dabrowski, PE President – Visionary, Inc. MBA, BS Mechanical Engineering. Registered Professional Engineer in Colorado, Florida and Ohio
- Daniel Hindman, Ph.D. Professor Virginia Tech, College of Natural Resources and Environment

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NAERMC
National Association of Environmentally Responsible Mold Contractors

Abstract

Abstract

Proposed Theory For Dating Water Event

Davis/Moon (Moon) at the 2015 Forensic Engineering Conference gave an oral presentation that proposed a theory for dating the duration of a water event based on measuring the Thickness Swell (TS) of water-exposed [particle board] sink cabinet side panels.

Moon finds that in addition to duration of water exposure, other factors (confounders) can significantly impact cabinet TS from water exposure.

Abstract

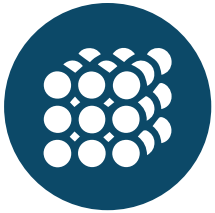
In Addition to Water Exposure

- Particle board density and water temperature are key factors (confounders) that determine the rate of TS in addition to length of water exposure.
- In a controlled test environment, one of course knows the temperature of the water exposure and can measure the density of the particle board cabinets.

Abstract

Significant Confounders

However in the field one can never know the temperature of the water that impacted the cabinets.



Neither can one ever know the cabinet density because measuring density requires cutting out a piece of the homeowner's cabinet and measuring off-site.

Destroying the homeowner's cabinets is often not an option.

Abstract

Unknowns Result in Fatal Flaws

- Since the water temperature and cabinet density can never be determined/known (or knowable) …

- The application of Moon's theory/ methodology for determining the duration of a water event is fatally flawed.
- Moon's study is claimed to have been professionally Peer Reviewed.
- But as we will show. NOT!

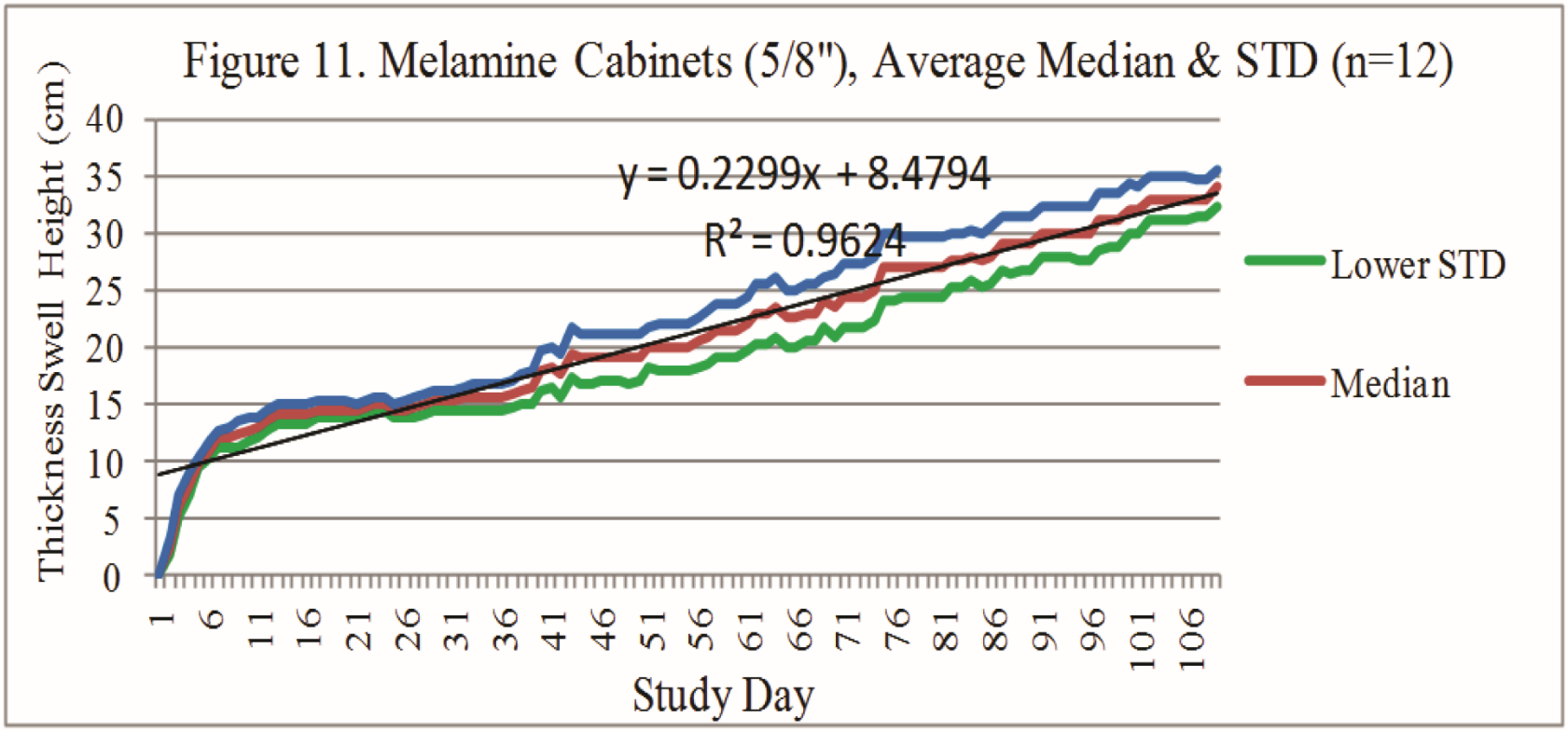
Abstract

Data Valuable

- While Moon's methodology/theory is flawed and of no value for reliably determine the duration of a water loss from particle board expansion…
- Nevertheless, the data itself is of enormous value.

Abstract

Moon's Data Is Of Enormous Value



- Moon shows that there is always massive permanent damage to particle board by Day 13.

Abstract

Huge Irreversible Damage < Day 14

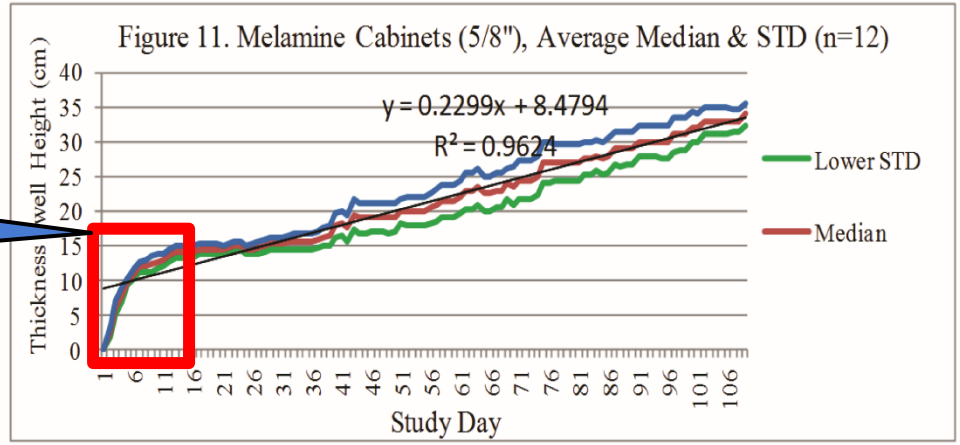
- While Moon's methodology/ theory are fatally flawed and of no value for predicting the duration of a water loss by measuring particle board thickness swell…
- Moon's data clearly shows that there is massive irreversible permanent damage to particle board during the first 13 days of water exposure that triggers a claim.

Abstract

Huge Irreversible Permanent Damage < Day 14

- Even if we accept Moon's methodology/theory for what happens to particle board with 60-100+ days of water exposure…
- This is irrelevant since the permanent damage before day 14 triggers coverage.
- Additional damage after day 13, has no impact on coverage.

Permanent Damage by Day 14



Abstract

Unintended Consequences

The unintended consequence of Moon's study is that he proves that no matter the duration of particle board exposure to water, because the cabinets are fully destroyed before Day 14, there is always Insurance Coverage.

Introduction

Introduction

Dating a Water Event

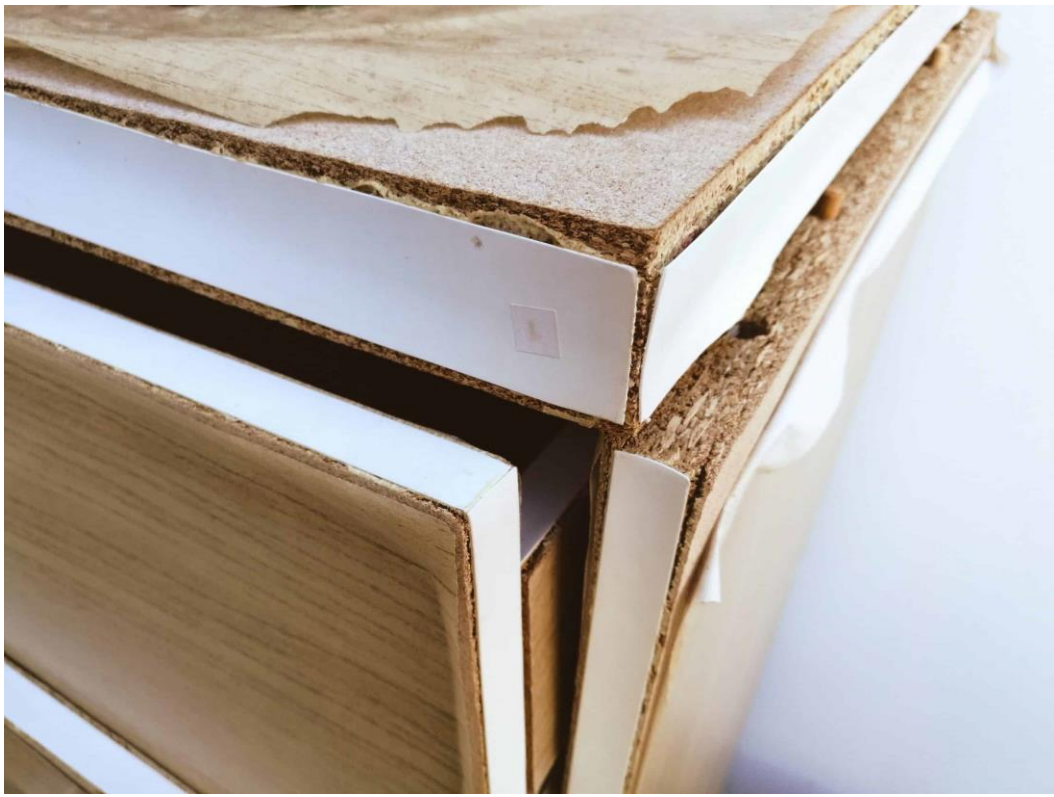
Forensic engineers working for the insurance industry attempt to show that they can accurately and reliably determine the timing and duration of any permanent water damage to help settle (actually deny) water leak claims.

Here they say they have developed a technique that can be used to make such a determination months or years after the water event.

Introduction

Limited Options for Dating an OLD Water Event

- Mold testing for how viable (new/fresh) mold growth is, immediately following a water event, can be useful to help determine the duration and timing of a leak.
- However this procedure is of no value months or years later.
- Particle board damage /swelling is irreversible and permanent.
- The Moon 2015 postulate is that particle board swelling can be measured months or years after water exposure and can prove long term damage … and support claim denial.



Introduction

Moon's Theory for Dating a Water Event

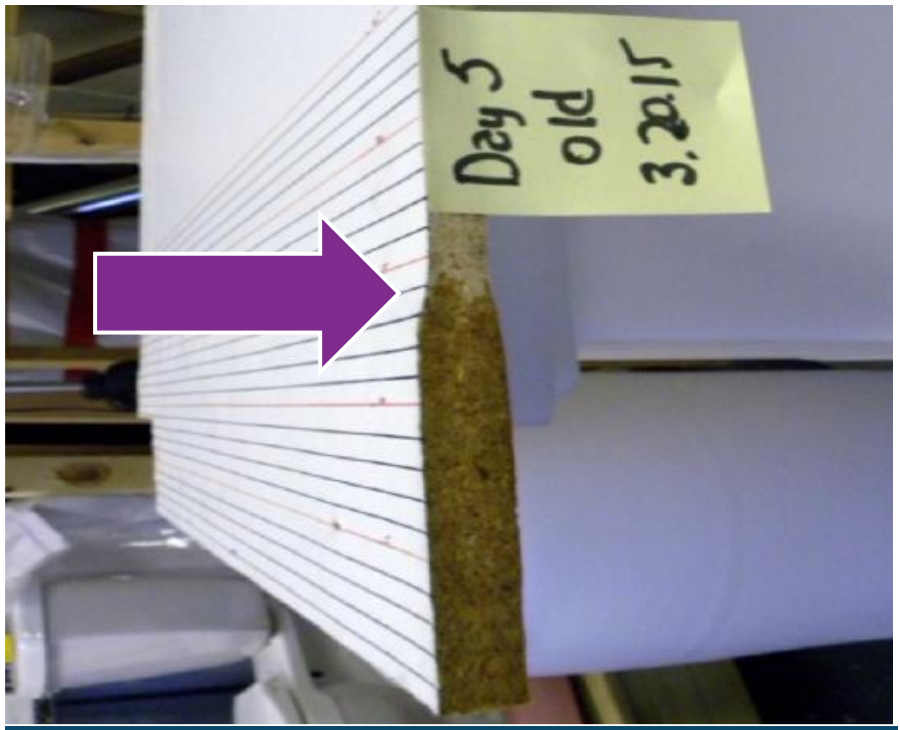
For the purpose of classifying a water loss as long term (> 13 days) or short term (< 14 days), Moon presented a theory in which measuring the height of cabinet side panel thickness swell (TS) from water exposure can be used as a basis for the determination of duration of water exposure months or even years after the event.

The theory and limited supporting experimental data were presented orally at the 2015 Forensic Engineering Conference and the conference proceedings later published online.

Introduction

TS Height & Duration of Water Exposure Theory

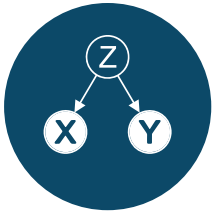
- When particle board cabinet side panel bottoms become wet as the result of a leak, they swell.
- The Moon theory postulates that one can accurately determine the duration of cabinet side panel water exposure by measuring the TS height and comparing to known experimental data….
- **However other factors strongly impact Thickness Swell (TS) besides duration of water exposure.**



Picture from Moon 2015 study. Thickness Swell (TS) height is 3.2 inches.

Introduction

TS Height Measurements Confounders



Moon states that many factors (confounders) other than water-contact duration (i.e. cabinet panel density) affect the rate and extent of TS.

All factors that significantly impact TS need to be accounted for when one attempts to reliably determine the duration of a water event by comparing field measurements of cabinet side panel TS height to reference timelines based on experimental data.

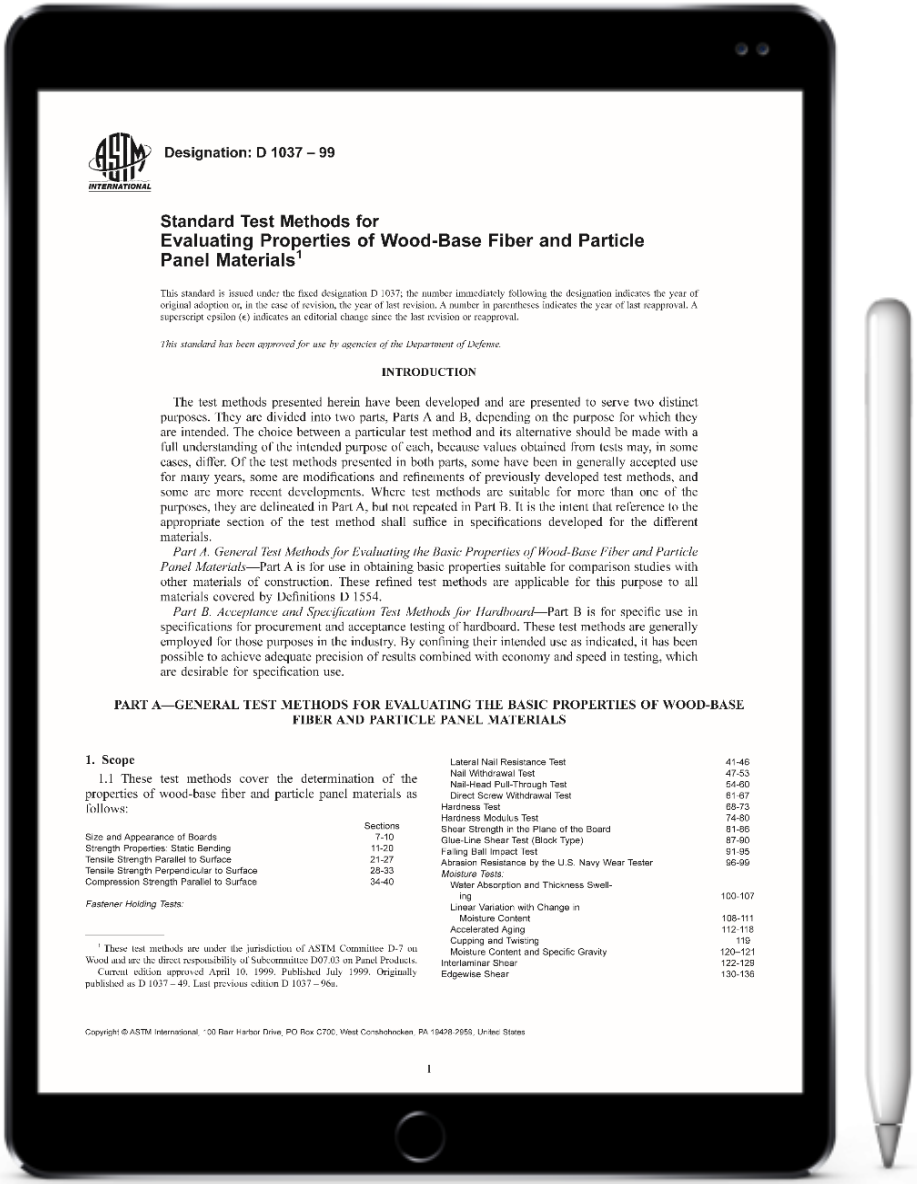
We will show that Moon does not control all the significant potential confounders / variables.

And as a result, Moon's theory when applied outside of the lab is not, and cannot be, reliable.

Introduction

TS Height Measurements Confounders

- Moon states that he measures thickness swell based on the ASTM D 1037 standard.
- However the measurements that Moon makes is on a different property than what is in ASTM 1037.
- Moon's methodology and procedures are proprietary.
- These proprietary methods and procedures are not capable of surviving a Daubert challenge.



Designation: D 1037 – 99

Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials[1]

This standard is issued under the fixed designation D 1037; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

INTRODUCTION

The test methods presented herein have been developed and are presented to serve two distinct purposes. They are divided into two parts, Parts A and B, depending on the purpose for which they are intended. The choice between a particular test method and its alternative should be made with a full understanding of the intended purpose of each, because values obtained from tests may, in some cases, differ. Of the test methods presented in both parts, some have been in generally accepted use for many years, some are modifications and refinements of previously developed test methods, and some are more recent developments. Where test methods are suitable for more than one of the purposes, they are delineated in Part A, but not repeated in Part B. It is the intent that reference to the appropriate section of the test method shall suffice in specifications developed for the different materials.

Part A. General Test Methods for Evaluating the Basic Properties of Wood-Base Fiber and Particle Panel Materials—Part A is for use in obtaining basic properties suitable for comparison studies with other materials of construction. These refined test methods are applicable for this purpose to all materials covered by Definitions D 1554.

Part B. Acceptance and Specification Test Methods for Hardboard—Part B is for specific use in specifications for procurement and acceptance testing of hardboard. These test methods are generally employed for those purposes in the industry. By confining their intended use as indicated, it has been possible to achieve adequate precision of results combined with economy and speed in testing, which are desirable for specification use.

PART A—GENERAL TEST METHODS FOR EVALUATING THE BASIC PROPERTIES OF WOOD-BASE FIBER AND PARTICLE PANEL MATERIALS

1. Scope

1.1 These test methods cover the determination of the properties of wood-base fiber and particle panel materials as follows:

[1] These test methods are under the jurisdiction of ASTM Committee D-7 on Wood and are the direct responsibility of Subcommittee D07.03 on Panel Products.

Current edition approved April 10, 1999. Published July 1999. Originally published as D 1037 – 49. Last previous edition D 1037 – 96a.

1

Introduction

Not Professionally Peer Reviewed

Designation: D 1037 – 99
Standard Test Methods for Evaluating properties of Wood-Based Fiber & Particle Panel Materials[1]

- While Moon claims that the basis of his measurements is the ASTM D1037 standard but in fact they are invented/ proprietary.
- It could be considered amusing that Moon claims that his presentation has been professionally Peer Reviewed but the reviewers were not familiar with the ASTM standard for testing wood fibers and particle board.
- Who were these Peer Reviewers?

Introduction

NO Peer Review

But NO doubt it would not be amusing to the many homeowners for whom water damaged kitchen cabinet coverage was denied due to this Moon “study”.

Moon Study Results Summarized by Professor Hindman (One of our Peer Reviewers)

- "The use of laboratory data detailing specific thickness swell behavior of particleboard under controlled conditions cannot be generalized to any particleboard source where details of the manufacture, age, specific gravity of board, temperature of water and other variables are unknown,"
- "No validation of the theory [Moon] created was every conducted by Moon or any other researcher."
- See Dr Hindman's full critique and C.V. in Appendix.

FLA 5TH DCA RULING & UNINTENDED CONSEQUENCES OF MOON'S STUDY

Per 5th DCA Ruling

Duration vs. Timing of Loss

- Based on the recent FLA 5th DCA ruling 2-23-18 (Case # 5D17-1282) …
  - Carriers have misapplied the 14 day clause which they use to deny coverage.
  - Just because a water event took place longer than 13 days and there was damage beyond Day 13, does not mean that the carrier is not obligated to pay for damages occurring before the 14 day exclusion.
  - In the event of a long term leak, the Carrier must prove that there is no permanent damage prior to day 14 in order to deny the claim.

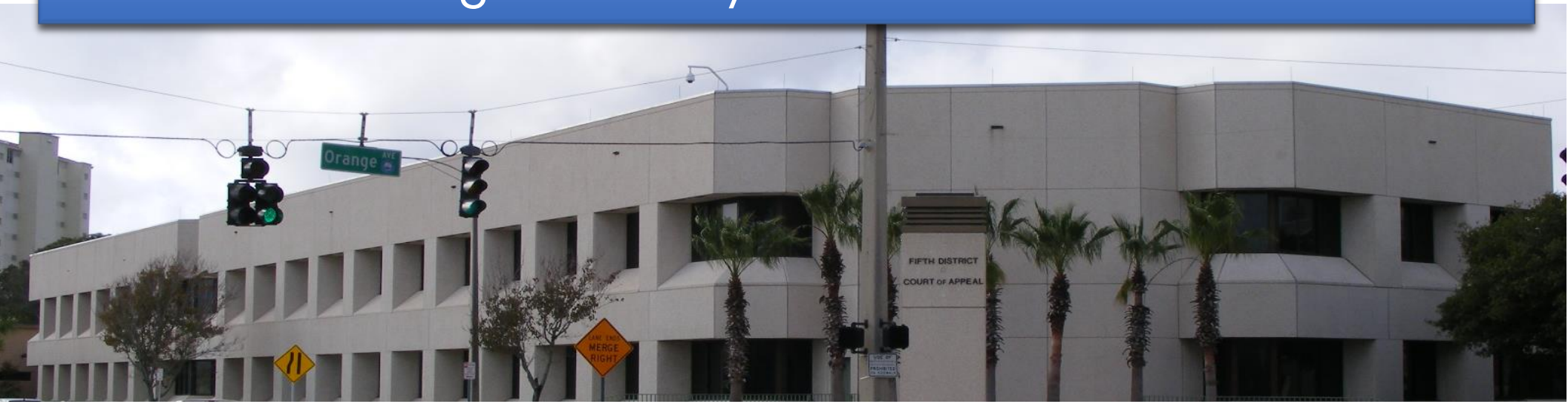
Just because the leak was long term, is NOT grounds for denial of coverage.

Per 5th DCA Ruling

Duration vs. Timing of Loss

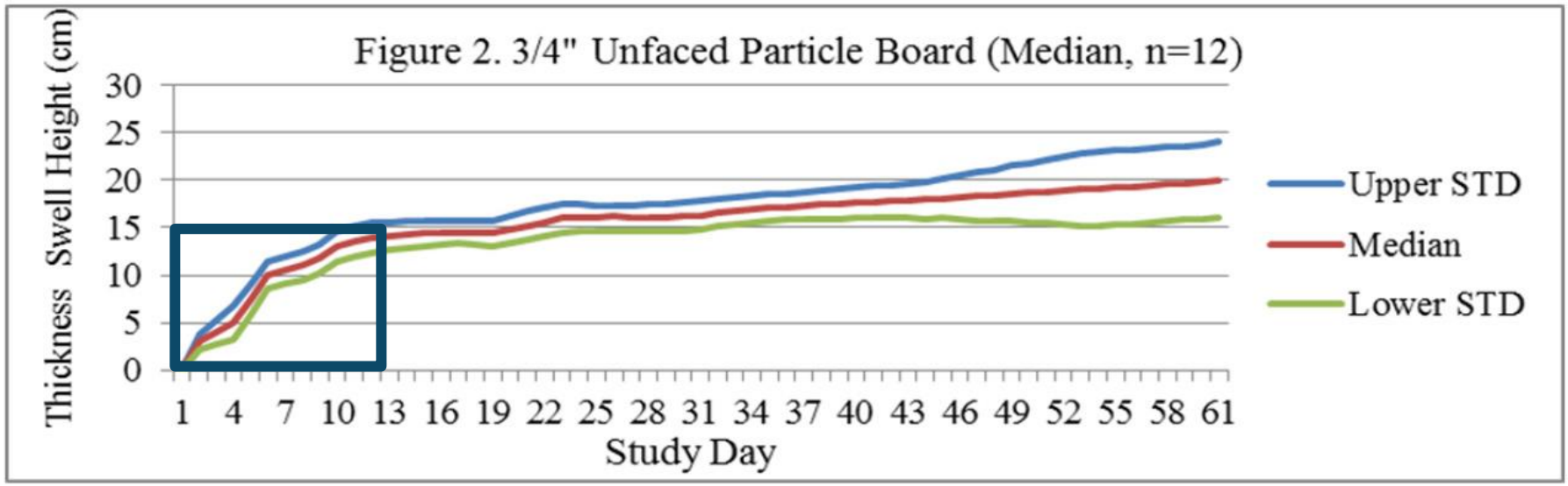
- Moon has gone to great lengths to develop a theory to be able to categorize a loss as long term.
- But the FLA 5th District Court of Appeals ruling has said that duration of loss is not the significant factor because if there was damage < Day 14, that by itself is a trigger for coverage.

Additional damage after Day 13 is not reason for claim denial.



Per 5th DCA Ruling

Timing of Loss



- Moon's data shows a massive spike in TS before Day 14. See example above (one of many similar examples) taken from Moon 2015.
- As Moon explains, this spike is irreversible.
- Moon goes to great lengths attempting to prove that a water event was long term.
- But if there was permanent damage prior to Day 14, so what.
- Additional water exposure and/or damage after Day 13 is now irrelevant to coverage.

Per 5th DCA Ruling

Unintended Consequences

Moon 2015 study rather than being of value in helping Carrier's deny coverage due to long term loss … Does an excellent job proving that massive water damage occurs to particle board during the first 13 days always triggering coverage.

Per FLA 5th DCA ruling, if there is damage before Day 14, the fact that there may be additional damage after Day 13 does not in any way result in coverage denial. The fact that the water event is long term and not short term, does not in any way impact coverage if there was damage before Day 14.

OUR OWN SIMPLE PARTICLE BOARD EXPERIMENT. PARTICLE BOARD DAMAGE IS FAST

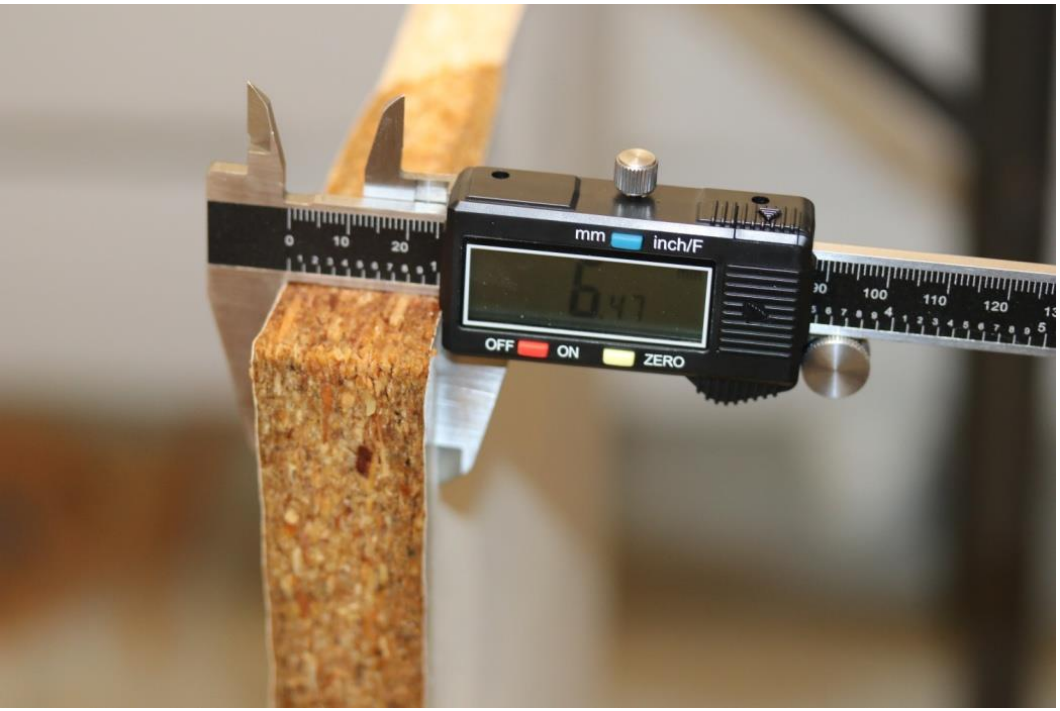
Re-Creating the Moon Study

- We purchased a piece of laminated particle board from Lowes and put it in water for 5 days to re-create the Moon experiments.
- We took pictures Day 1, Day 3, Day 5.
- Simple enough. No charts, no tables … just some pictures.
- Here's what we found.

After 1 Day

- Particle board. Laminated both sides.
- After 1 day. Beyond repair.

After 3 Day



- After 3 days. Even worse.

After 5 Days. Massive Damage

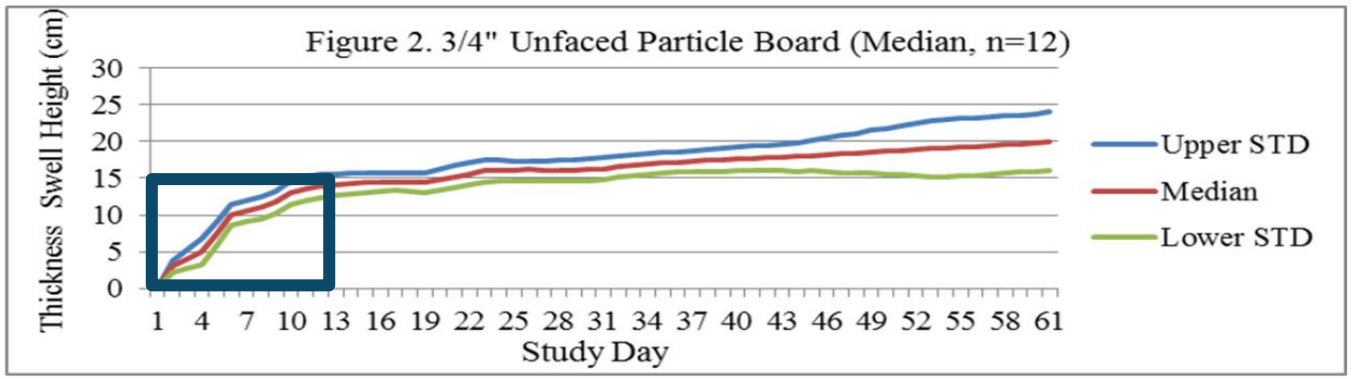
After 5 Days. 4.5” TS Height

After 5 Day

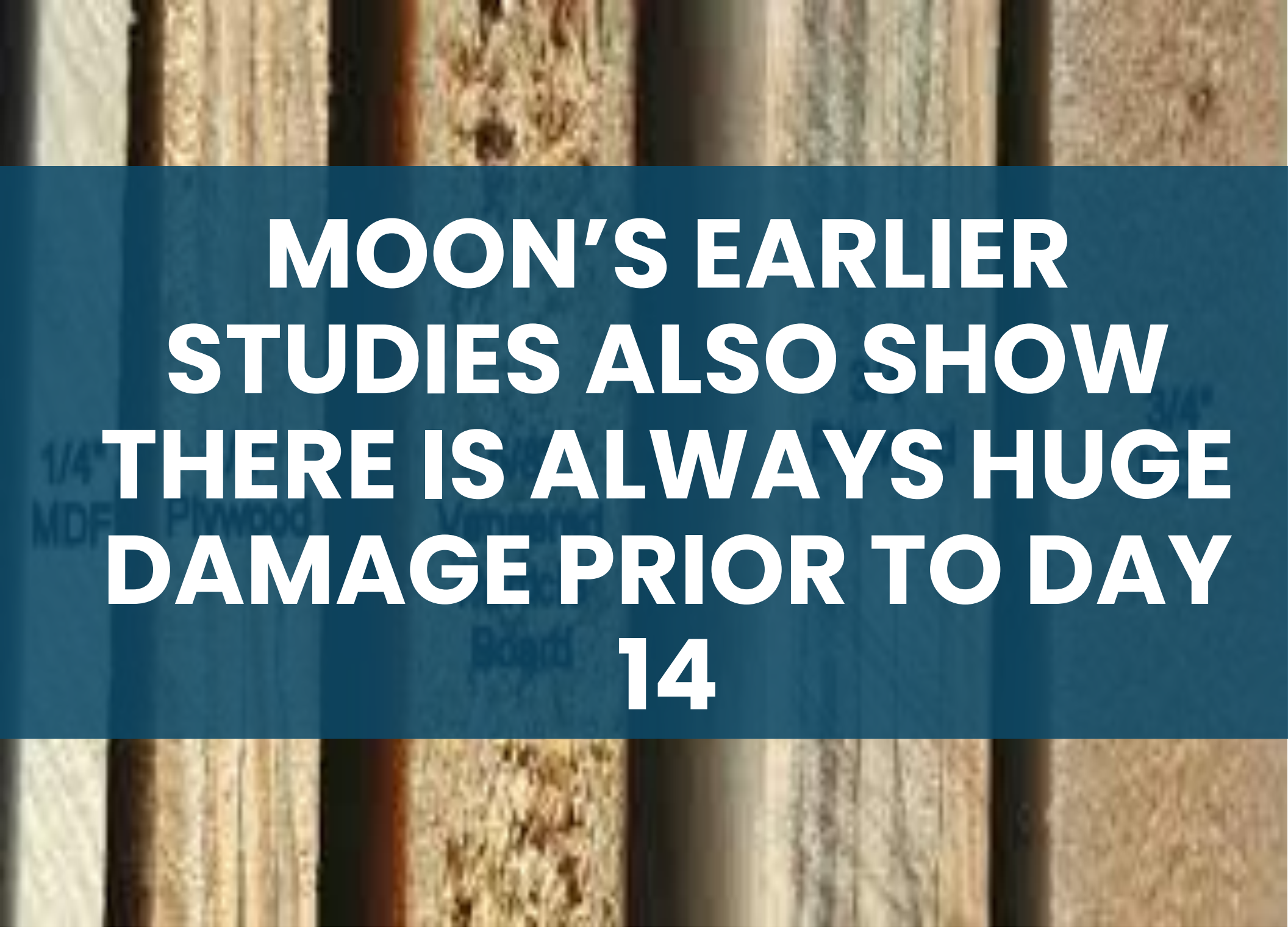
- After 5 days, massive damage from swelling. Similar (somewhat) greater swell height than Moon's Figure 1.

What We Found In Our Re-Creation of Moon

- One can clearly see that there is massive damage before Day 14.
- We can clearly see that there is a spike in swelling the first few days as is also clearly seen in Moon's data.



As a result, even if the water event is long term (> 13 days) because there is ALWAYS permanent damage before day 14, there is ALWAYS a valid water loss claim when particle board cabinets get wet.



MOON'S EARLIER STUDIES ALSO SHOW THERE IS ALWAYS HUGE DAMAGE PRIOR TO DAY 14

Pressed Wood

- Pressed Wood as compared to plywood is either Particle Board or MDF (Medium-density fiberboard).
- Kitchen cabinet side panels are usually particle board.

Moon's Earlier 2009 Study

Rate of Particle Board Expansion FAST

http:// clmmag.theclm,org/home/article/feeling-the-heat

10/20/2009

Feeling the Heat

Hot water can wrap an adjuster's perspective on water-damaged wood composite materials.

By Ralph E. Moon, Ph.D., CHMM, CIAQP

Water losses lead personal property claims in the U.S., but are they as well understood as they are widely prevalent? A recent study shows that when density fiberboard (MDF), non-faced particleboard and Melamine (faced particleboard) exposed to water, dramatic dimensional changes occur at water temperatures above 85°. **The swollen appearance of these wood are composite materials was consistent with long-term exposure to moisture, although the exposure period was only 30 minutes**. The test results underscore the importance of understanding the effects of elevated water temperatures on composite wood materials used in cabinetry, furniture and trim when supporting decisions of duration of loss.

Moon's Earlier Studies

Rate of Pressed Wood Expansion FAST

- After only 30 minutes of water exposure (according to Dr. Moon) swollen appearance of particle board was consistent with long term exposure.
- Clearly particle board swelling is too fast to be useful in determining the duration of a water loss.
- Clearly significant damage occurs before Day 14, triggering coverage regardless of the duration of loss.

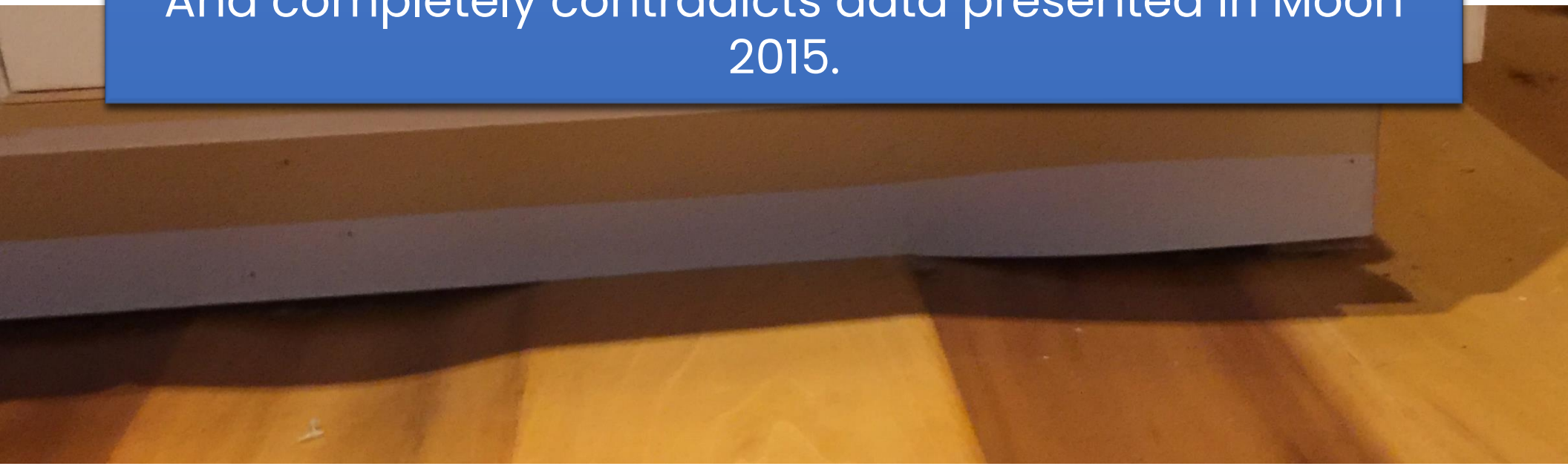
Moon's Earlier Studies

Rate of Pressed Wood Expansion FAST

In Moon 2015, he presents a theory that there is long term damage to particle board upon exposure to water that can be useful in dating a water event.

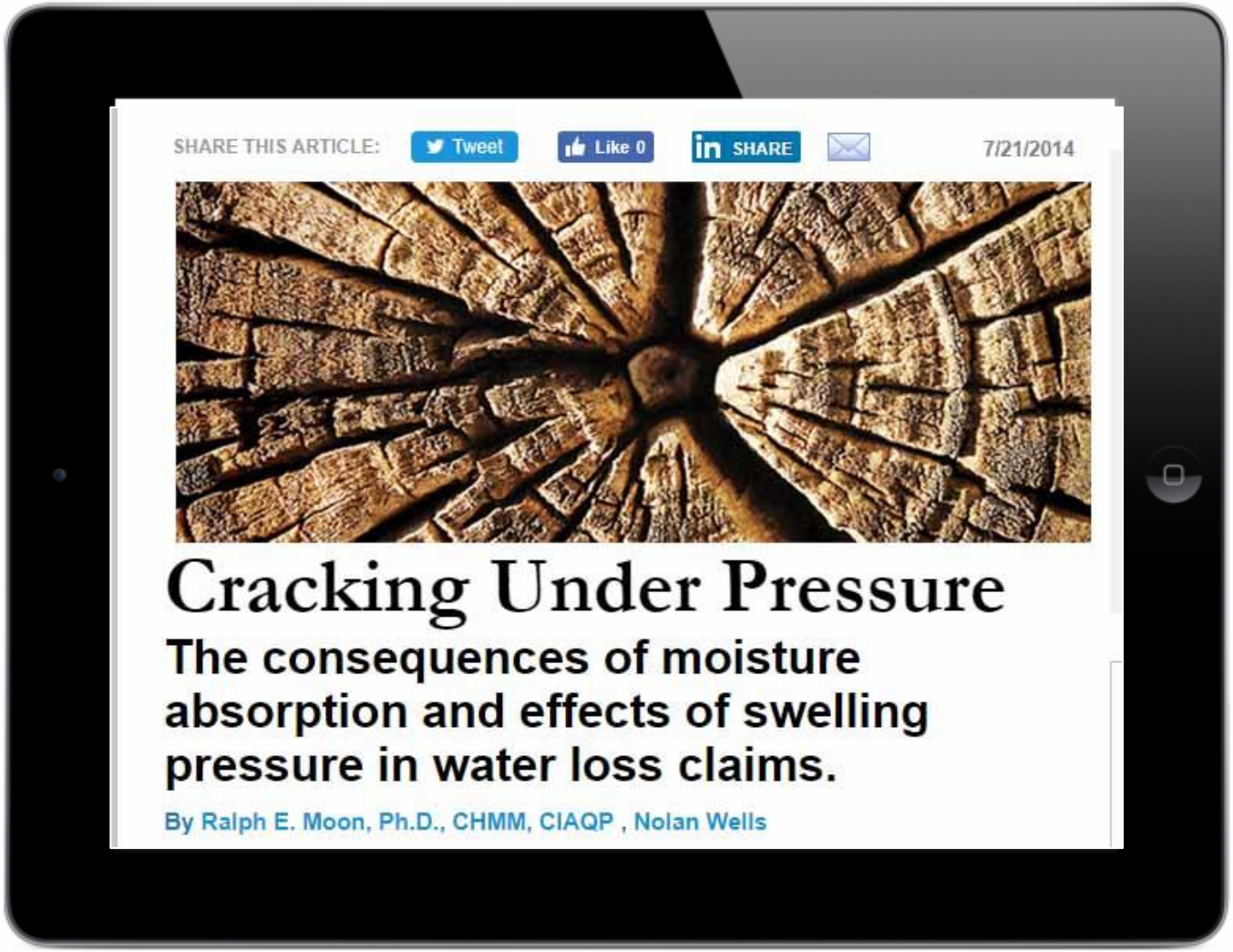
But neglects to mention his earlier study [2009] that found that particle board **looked like long-term exposure after only 30 minutes**.

And completely contradicts data presented in Moon 2015.



Moon's Earlier 2014 Study

Rate of Pressed Wood Expansion FAST



Moon's Earlier Studies

Rate of Pressed Wood Expansion FAST

- Dr. Moon in this 2014 published the article *Cracking Under Pressure*:

  "Pressure [water pressure on the particle board] increased as moisture content reached saturation;

  "Maximum pressure occurred **within the first two days** of moisture exposure in most samples."

Moon's Earlier Studies

Rate of Particle Board Expansion FAST

- Maximum pressure occurred **within the first two days** of moisture exposure.
- Clearly significant particle board damage occurs well before Day 14 which triggers coverage.
- If there is any additional damage/swelling after Day 13, that does not affect coverage.

Moon's Earlier Studies

Contradicts Data in Moon 2015

In Moon 2015, Moon neglects to mention/ reference his earlier studies that found that particle board expansion spiked within 2 days.

These earlier studies completely contradict the findings in Moon 2015.

Is there any wonder why these two earlier studies (by Moon) were then not referenced in Moon 2015.

HAS THE MOON 2015 FORENSIC CONFERENCE PRESENTATION BEEN PEER REVIEWED?

Peer Review

When You Criticize/ Find Errors

When you criticize/ find inconsistencies and errors with a theory, or application of a theory such as with Moon, the opposing attorney is going to turn Peer Review against you.

He may not read one word of your analysis but will challenge it by saying:

Moon's work is Peer Reviewed. Is yours?

When You Criticize/ Find Errors

The ONLY Good Response

The only good response is:

We can prove beyond all doubt that the expert's so-called Peer Reviewed theory has no merit and was **not professionally Peer Reviewed.**

And/or … our analysis and conclusions have been Professionally Peer Reviewed by Independent Experts and; With full disclosure as to who they are.

Peer Review

Questions to Be Answered Regarding Peer Review

- Has the Moon 2015 conference oral presentation been thoroughly and professionally Peer Reviewed by qualified reviewers as claimed?

Peer Review

Moon Refers to This Study As "Peer Reviewed"

"Peer-review moisture absorption studies published by the American Society of Civil Engineering, Forensic Engineering Congress on particle board cabinet panels revealed that the median thickness swelling height corresponded to extended duration of constant or repeated moisture exposure of 48 days. This estimate was reported within a 95% confidence interval of 39 to 58 days (Davis et al., 2015)"

When providing evidence for claim denial, Moon references the Moon 2015 oral presentation as "Peer Reviewed".

Attorneys that hired Moon, then believe that they have carte blanche to treat everything in the referenced article as well as all conclusions used for claim denial as scientific fact.

Peer Review

Not All Peer Reviews The Same

But of course, not all Peer Reviews are the same.

Some are simply called Peer Reviews to give the appearance of science.

Here we will show beyond any doubt that Moon 2015 has not being properly Peer Reviewed.

It is NOT actual science.

Scams/Rigging

Peer Review scam discussion on Google:

- https://www.nature.com/news/publishing-the-peer-review-scam-1.16400
- https://hub.wiley.com/community/exchanges/discover/blog/2017/09/11/how-transparency-can-abate-peer-review-scams
- https://retractionwatch.com/2014/11/26/the-peer-review-scam-how-authors-are-reviewing-their-own-papers/

How Do You Challenge the "Peer Review" Claim

- How do you prove that the material (in this case Moon's oral presentation on Thickness Swell) was NOT appropriately Peer Reviewed? Questions to ask:
  - Did the reviewers have a copy of the write up of the talk before the talk was given? (Generally no way.)
  - Or was only the abstract of the talk approved and that is called Peer Review?

Was there a real Peer Review or only a facade?

- **Questions to ask:**
  - Were the names and contact information of the reviewers disclosed?
  - Were the so-called reviewers provided the actual data used as the basis of charts, graphs or derived results in order to perform a thorough Review?
  - What was the technical background of the reviewers?
    - Were they independent?
    - Where they consultants for insurance carriers and therefore had a conflict of interest?

- Were the reviewers given copies of Moon's earlier (2009 and 2014) published articles (also considered Peer Reviewed?)
- If so how do they explain the contradictions?
- If not, Moon 2015 was NOT professionally Peer Reviewed.

References in Moon 2015

Did [Alleged] Reviewers Review Moon's Earlier Contradictory Work?

References

ASTM, Standard Test Methods for Evaluating Properties of wood-base Fiber and particle Panel -Materials (Part A. Water Absorption and Thickness Swell). Standard D1037-12 ASTM international,2012

Cai, Z., Wu, Q. Lee, J,N., and S. Hiziroglu (2004), "influence of board density, mat construction, and chip type on performance of particleboard made from eastern red cedar," Forest Product Journal, Vol.54 (12), 226-232

Carll, C, G., (1997). "Review of Thickness Swell in Hardboard Siding Effect of Processing Variables", United State Department of Agriculture, Forest Products Laboratory, General Technical Report FPL-GTR-96, 10 pages.

No reference to Moon's two earlier contradictory studies listed in Moon 2015 reference list. Why? Because they came to the exact opposite concludes. Pressed wood cabinets are irreversibly destroyed without hours after the bottoms come in contact with water.

References in Moon 2015

Did [Alleged] Reviewers Review Moon's Earlier Contradictory Work?

Carll, C,G. (1986) Wood particleboard and Flakeboard: Types, Grades and Uses, Gen Tech, Report FPL-GTR-53. Madison WI: U.S. Department of Agriculture, Forest Services, Forest Products Laboratory.9 pages.

Davis, B., Moon R. and D. Rondy, (2012). " Differnce in Cabinet Damges Exposed to water and water with Detergent," In: American Society of Civil Engineers, Forensic Products Laboratory. 9 pages.

Forest products Laboratory, (1999). Wood handbook- Wood as an engineering materials. Gen Tech Rep. FPL-GTR-113. Madison WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory, Chapter 10, 463 pages

Hofferber, B.M., Kolodka E., Brandon, R., Moon, R., Frihart, C.R., (2006). Effects of Swelling Forces on the Durability of Wood Adhesive Bonds", In: Proceedings of the 29th Annual Meeting of The Adhesion Society, Inc, February 19-22, 2006.

Wisherd K.D. and J.B Wilson, (1979). Bark as a supplement to wood furnish for particle board, Forest Products Journal, Vol. 29(9),35-39.

No reference to Moon's two earlier contradictory studies listed in Moon 2015

Peer Review

Prior Moon Studies on Pressed Wood Expansion Not Referenced

The contradictory studies published by Moon in 2009 and 2014 were not listed/ referenced in Moon 2015.

That is certainly proof that there has been no real Peer Review of Moon 2015.

Moon NOT Peer Reviewed

Full of Technical Errors

Thickness Swell in particle Board: A forensic Tool for the Duration of loss

Brett Davis, CRC[1] and Ralph E. Moon, Ph.D.[2]

[1.2] GHD, 4019 East Fowler Avenue, Tampa, Florida. E-mail: Brett.Davis@ghd.com;

Ralph.Moon@ghd.com

- We look at the collection of technical errors and misstatements in Moon's write up of an oral presentation given at the 2015 Forensic Engineering conference.
- Moon claims that this presentation was professionally Peer Reviewed but as we will show with complete certainty, it was not.
- Was published by GHD, an Insurance Defense firm.

Moon NOT Peer Reviewed

Full of Typos & Grammatical Errors

Not only are there multitudes of technical errors and misstatements, but there are also typos and grammatical errors throughout.

So even a non-technical person reviewing this oral presentation would find extensive “errors”.

With complete certainty we will show that Moon 2015 has Not Been Professionally Peer Reviewed

MAJOR PROBLEMS WITH MOON 2015

TS Rates Depend on Multiple Factors

Conclusions

Particle board panels absorbs moisture at **predictable rates** depending on panel thickness adhesive presence of a surfactant and **density.**

- From Moon 2015:
  - Thickness Swell (TS) rates are predictable **depending on multiple factors** … including cabinet panel **density**.
- Moon concludes: TS rates can be predictable **depending on cabinet panel density** and other factors.
- And yet Moon will reference this study as proof for the determination of a very precise period of long term water exposure **without ever measuring the density of the insured's cabinets upon which TS height depends!**

Major Problems

TS Rate Depends on The Insured's Cabinet Pressed Wood Density, Which Is Always Unknown

As we shall see, Moon makes definitive conclusions on duration of a leak by measuring TS height … without knowing density of the insured's cabinet panels.

Yet this work is used by Carriers to deny coverage because attorneys do not read studies.

Moon 2015 has been (is claimed to have been) Peer Reviewed!

Therefore everything in it, and everything that references it, is "Golden" and should not be challenged according to Defense Attorneys.

Catch 22

- Catch 22: One must account for particle board density when one is proposing theory regarding TS height into practice.
  - This means measuring the particle board density of the insured cabinets.
  - But determining particle board density requires that a piece of cabinet be cut out, dried and weighed.
  - **In practice, this is impossible as it requires the "destruction" of the homeowners cabinets.**

Major Problems

Insured Panel Density Never Known

In practice, determining particle board density outside of the lab is impossible as it requires the "destruction" of the insured's cabinets which is never permitted by the insured.
So this is NEVER done.
Because the insured's cabinet panel density can never be known, application of Moon's theory to the real world is entirely without merit.
Yet this is used by Carriers to deny coverage.

Major Problems

Other Important Factors Not Known

- Other factors can be important in impacting TS rates/heights, not considered (controlled) by Moon, include:

Cabinet panel age

Temperature of water exposure.

Manufacturing process variables (press pressure, press temperature, press duration).

Additive content including wax.

More Problems With Moon 2015

- Moon shows that panel age and water temperature greatly impact TS height/rate.
- But these factors are not considered by Moon when applying experimental results to real world application.
- As a result, the theory put forth by Moon as to determining leak duration by measuring TS swell height is entirely without merit when applied to real world water events.

Major Problems

Moon Not Peer Reviewed. Has Serious Deficiencies

Due to the many serious deficiencies in Moon 2015, we will show:

- Is NOT suitable for use by Carriers to deny coverage.
- Again, has NOT been professionally Peer Reviewed as claimed.

MOON CABINET SIDE PANEL TS STUDY OVERVIEW

Moon TS Study Overview

Questions to Be Answered per Moon

Excerpt from Moon Abstract:

- "When a water loss damages a home and insurance coverage is anticipated, the investigator is often asked a critical question: When did the loss occur?"
- "Water losses frequently damage cabinetry because composite wood products (i.e., particle board) are vulnerable to thickness swell (TS)."

Moon TS Study Overview

Study Examined Different Types of Panels

- Moon 2015 study: "Multiple panels (unfaced, vinyl-faced, and melamine faced) were measured for the vertical moisture absorption under conditions of constant moisture exposure, over periods from two to four months."

Moon TS Study Overview

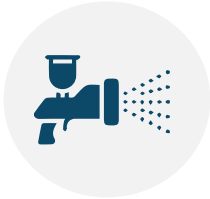
TS Height Confounders Studied

- Moon lists the following as potential confounders that were studied that may influence the rate of increase of TS height besides water exposure duration:

Particle board thickness (Found Highly significant)

Particle board density (Found Highly significant)

Binding Adhesive (Not very significant)



Type of Coating (Not very significant)

Detergents in water (Not very significant)

Known TS Height Confounders NOT Considered

- Water Temperature (Highly significant but not considered in this (Moon 2015) study.
- Age of particle board (Highly significant but not considered in this (Moon 2015) study.
- Humidity
- Wood species of particle board
- Size of particle board wood particulates
- Construction of particle board layers
- Whether water leak was continuous or intermittent
- Manufacturing process variables (press pressure; press temperature; press duration)
- Additive content including wax to prevent thickness swell.

Moon TS Study Overview

Potential Confounders NOT Studied

- Potential cofounders that may affect outcomes but not addressed by Moon:

The weight of the countertop and items stored in the cabinet pressing down on the cabinet side panel bottoms immersed in water.

Whether tile/stone flooring has been installed around the cabinet, resulting in water pooling below the cabinets after a leak.

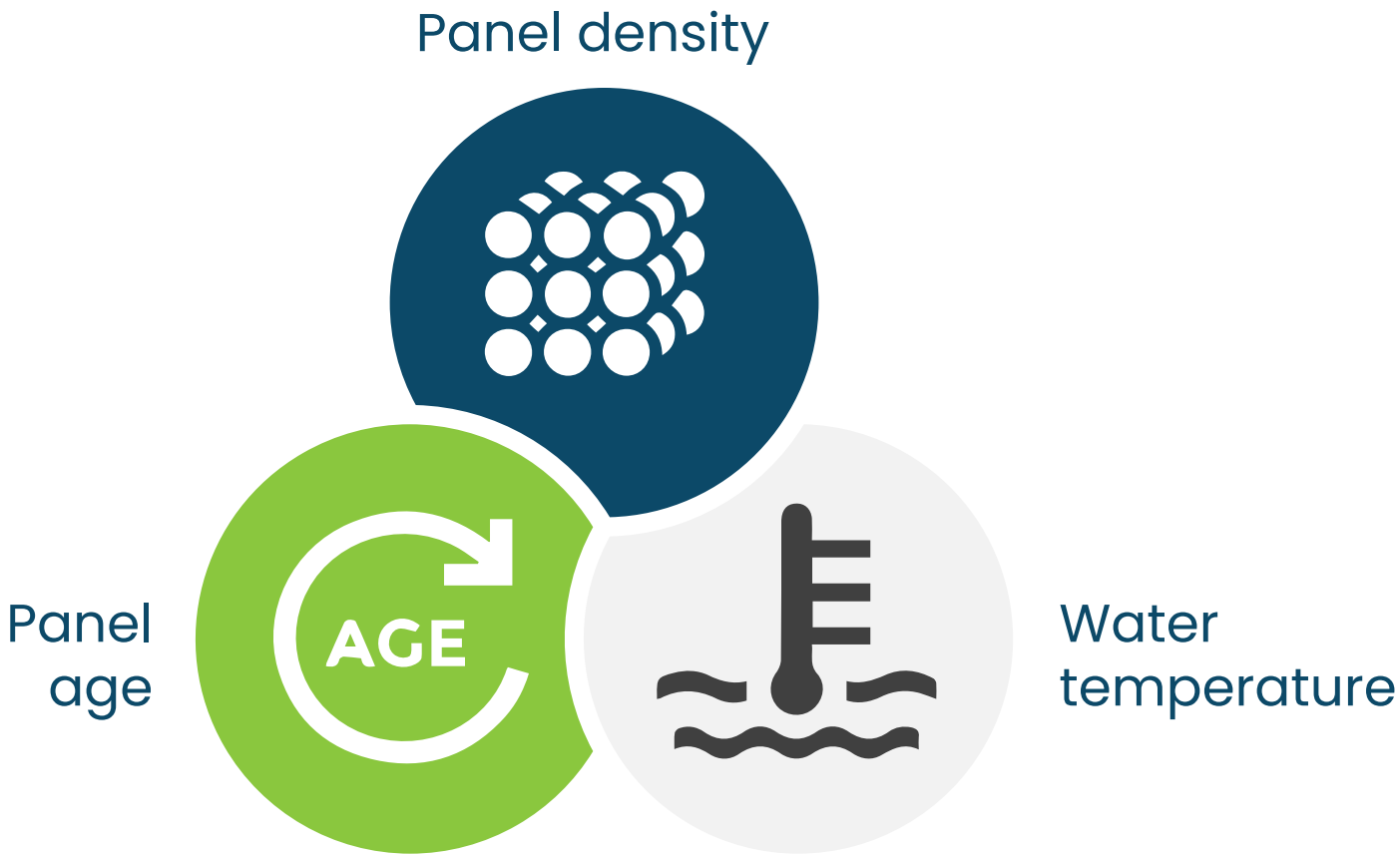
Whether the cabinet side panel bottoms are on a wet, slow to dry, concrete slab.

Category of Water: Clean or Contaminated

Moon TS Study Overview

Primary Confounders

- At a minimum, based on Moon 2015 and his previous published work the following three are Significant/Primary confounders.



Moon TS Study Overview

Primary Confounders

- If the experimental lab results regarding the rate of TS height increase are going to be applicable to an actual water damaged kitchen sink cabinet …
- At a minimum, these 3 Primary confounders that will significantly affect TS height rates must be considered / controlled.

Moon TS Study Overview

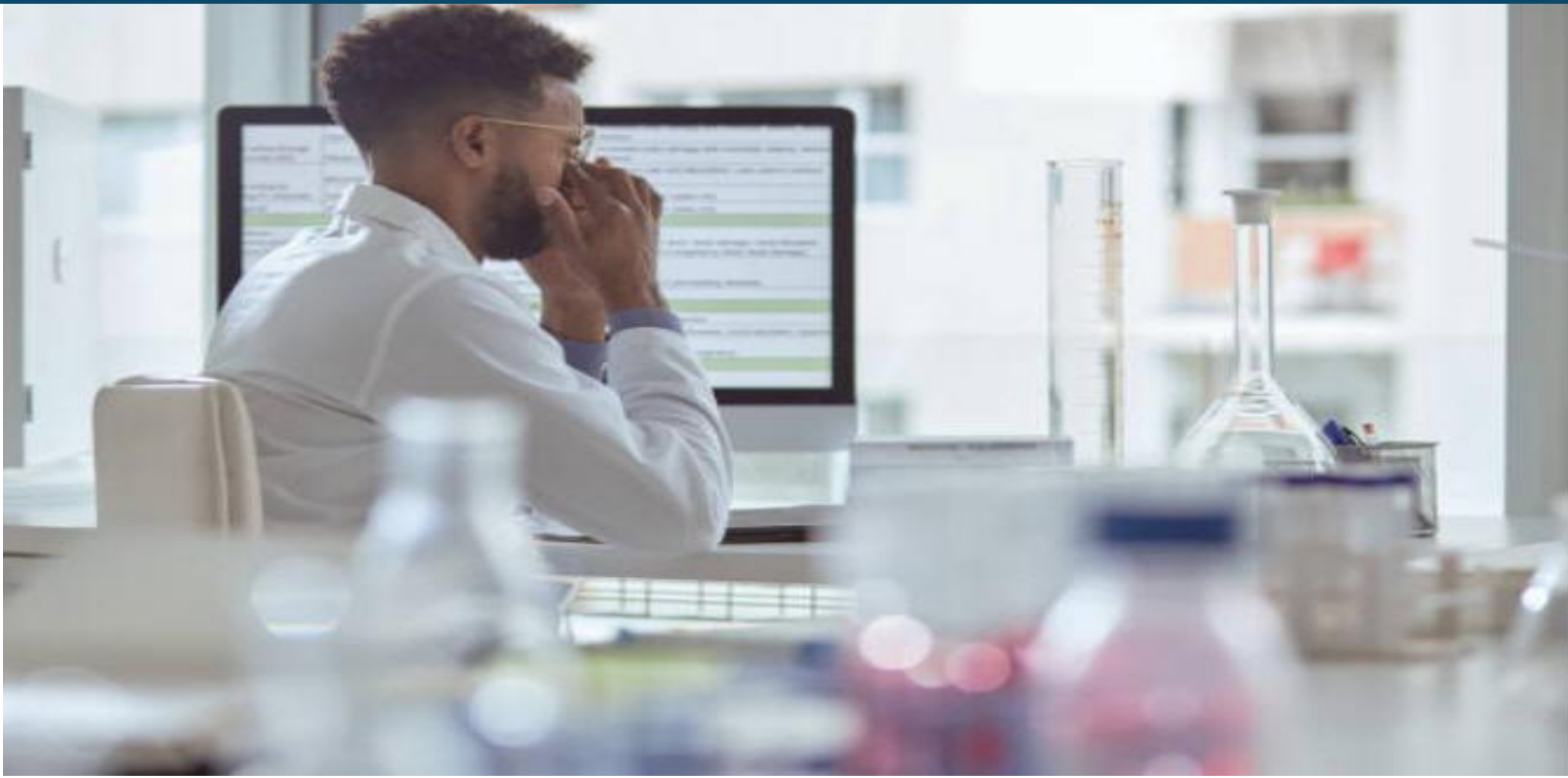
Primary Confounders

But in the real world you will never know the panel density or the temperature of the water that the cabinets were exposed to.

And will rarely know cabinet age in older homes.

Without this knowledge the entire Moon theory falls apart.

DAUBERT/ SCIENTIFIC METHOD ISSUES



Daubert Questions

- Has the (Moon 2015) technique/theory been subject to peer review and publication?
  - *We will prove definitely not.*
- Has the technique/theory been tested in actual field conditions (and not just in a laboratory)?
  - *No. There has been no field experiments by Moon where known duration of loss is compared to Thickness Swell measured in a lab by Moon.*
- What is the known or potential rate of error?
  - *We will show that Moon misrepresents and/or miscalculates rates of errors, therefore the technique CANNOT be reliably used as the basis for determining the length of particle board cabinet expansion due to moisture.*
- Do standards exist for the control of the technique's/theory's operation?
  - *The technique/theory used by Moon is proprietary. Not per any standard.*

Daubert Questions

- Has the technique/theory been generally accepted within the relevant scientific community?
  - *The technique/theory used is proprietary. Not generally accepted.*
- Has the technique/theory principles and methods developed in the experimental lab study phase been reliably applied to field measurements [Apple vs Oranges, or not?]
  - *We will show that the conditions upon which the experiments are set up, are NEVER appropriate for the field measurements Moon is performing.*

Daubert/Scientific Method?

Moon's Methods Fail Daubert

Moon Fails Daubert: The theories and techniques employed by Moon are NOT generally accepted in the scientific community (Daubert requirement);

Moon Fails Daubert: While Moon claims that his theories have been subjected to Peer Review, here we will prove that they have NOT been Peer Reviewed (Daubert requirement).

Moon Fails Daubert: We will show that Moon's theories/ techniques have a grossly unacceptable rate of error due to failure to account for confounders such as particle board density; water temperature; panel age; and microbial contamination;

Moon Fails Daubert: Moon's technique/theory has NOT been tested in actual field conditions (but only in a laboratory).

Daubert/Scientific Method?

Moon's Methods Fail Daubert

- What assumptions were made? Are they reasonable?
  - *We will show that assumptions about density, age, water temperature have been made by Moon that make no sense at all.*
- Is there enough information present for a 3rd party to reproduce graphs or equations generated or is the data hidden?
  - *No. We will see there are no data sets to go along with the charts, graphs and equations.*

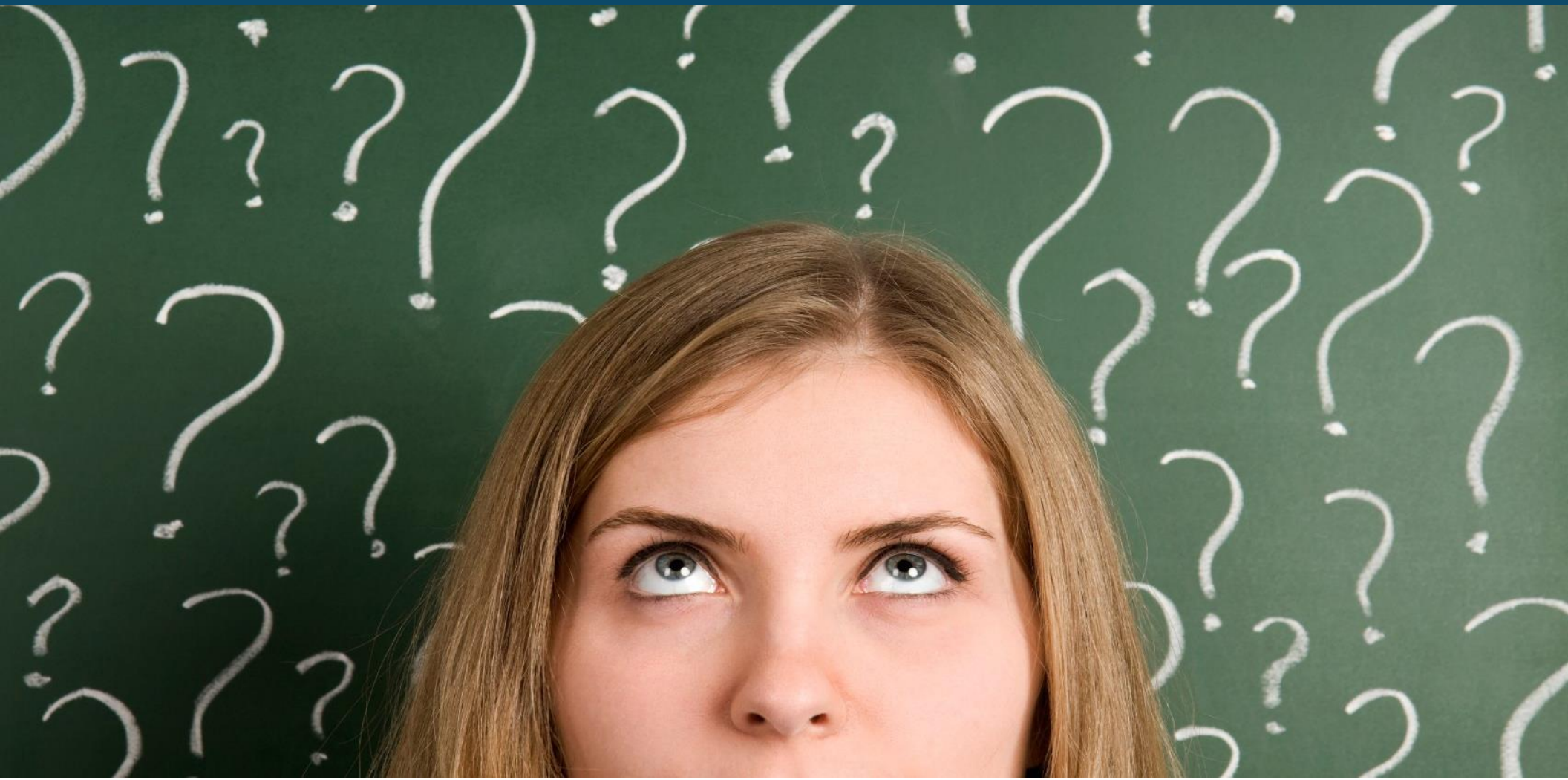
Daubert Questions

Moon's Methods Science or Not?

- Is there a way to check to see if the conclusions reached (duration of loss based on thickness swell height) are accurate/ reliable?
  - *Not at all. The position Moon takes is that since the theory has been called "Peer Reviewed" it is a scientific fact and cannot be challenged.*

Science or Not? Not!

BAD ASSUMPTIONS MADE BY MOON



Experiments At >94% Relative Humidity

"Multiple panels (unfaced, vinyl-faced, and melamine faced) were measured for the vertical moisture absorption under conditions of constant moisture exposure, elevated **relative humidity (>94% RH),** and slight elevated room temperatures (77-81°F)."

>94% humidity under which Moon study was performed is not the real world.

Any knowledgeable reviewer would question whether a study at >94% humidity is in any way useful or a reliable technique for estimating the duration of a water loss in a real-world air conditioned home.

Conclusion: Not Peer Reviewed

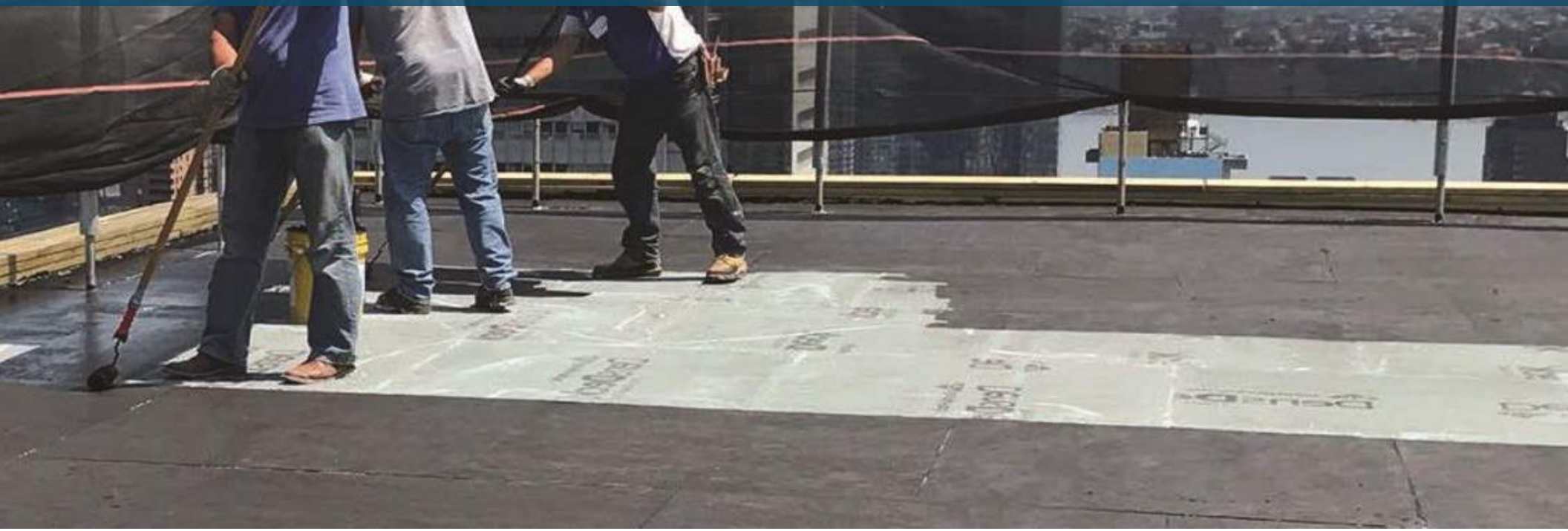
Some Circumstance Reliable

"Periods from two to four months. The test results revealed that **some circumstances** offer a reliable technique to estimate the duration of a **one time, continuous water loss when combined with other facts and observations."**

- Moon says: "some circumstances offer a reliable technique?" What are those?
- Certainly not >94% humidity!
- Any competent reviewer would require that the phrase "some circumstances" be defined.

Conclusion: Not Peer Reviewed

CONFOUNDER #2 ONLY APPLIES TO CONTINUOUS LEAKS



"Reliable for One Time, Continuous Water Event"

"Periods from two to four months. The test results revealed that **some circumstances** offer a reliable technique to estimate the duration of a **one time, continuous water loss when combined with other facts and observations.**"

- Reliable for one time, continuous water leaks.
- This means: Not necessarily reliable for intermittent leaks.
- Moon immerses the bottoms of sink cabinet panels in water for 60 to 100+ days.
- Is that a realistic test scenario? NO!
- Leaks are generally intermittent:
  - Drain line leaks are only a problem when water is running …only a short period per day.
  - Shower pan leaks are only a problem when water running …only a short period per day.
  - Dishwasher leaks are only a problem when running a dishwasher …only a short period per day.
- Pressurized line leaks that flood the residence are continuous but how often does a flood go on for 60-100+ days. NEVER

From Moon's Drip Drip Drip Article

http:// clmmag.theclm,org/home/article/drip-drip-drip

Drip, Drip, Drip 10/20/2009

A look at the inside of cabinet can reveal whether water damage resulted from a one-time event or a chronic leak.

- Moon discusses the characteristics of a typical leak as being low volume, and **intermittent**.
- Not at all like the Moon 2015 experiments where the bottoms of cabinets were immersed in water continuously for over 60-100+ days.

From Moon's Drip Drip Drip Article

"When water damage occurs inside a cabinet, usually originates as **low-volume, intermittent leak** from the drain or water supply. When kitchen and bath vanity damage is incurred, replacement costs can range from a hundred to a thousand dollars or more per linear foot, so there is an incentive to understand more precisely how cabinets respond to moisture."

- Per Moon: Low-volume & intermittent is how leaks usually occur.
- Nothing like the conditions in Moon 2015.
- In Moon 2015 they are comparing Apples to Oranges. The experiment is not in any way applicable to usual leaks **per Moon.**

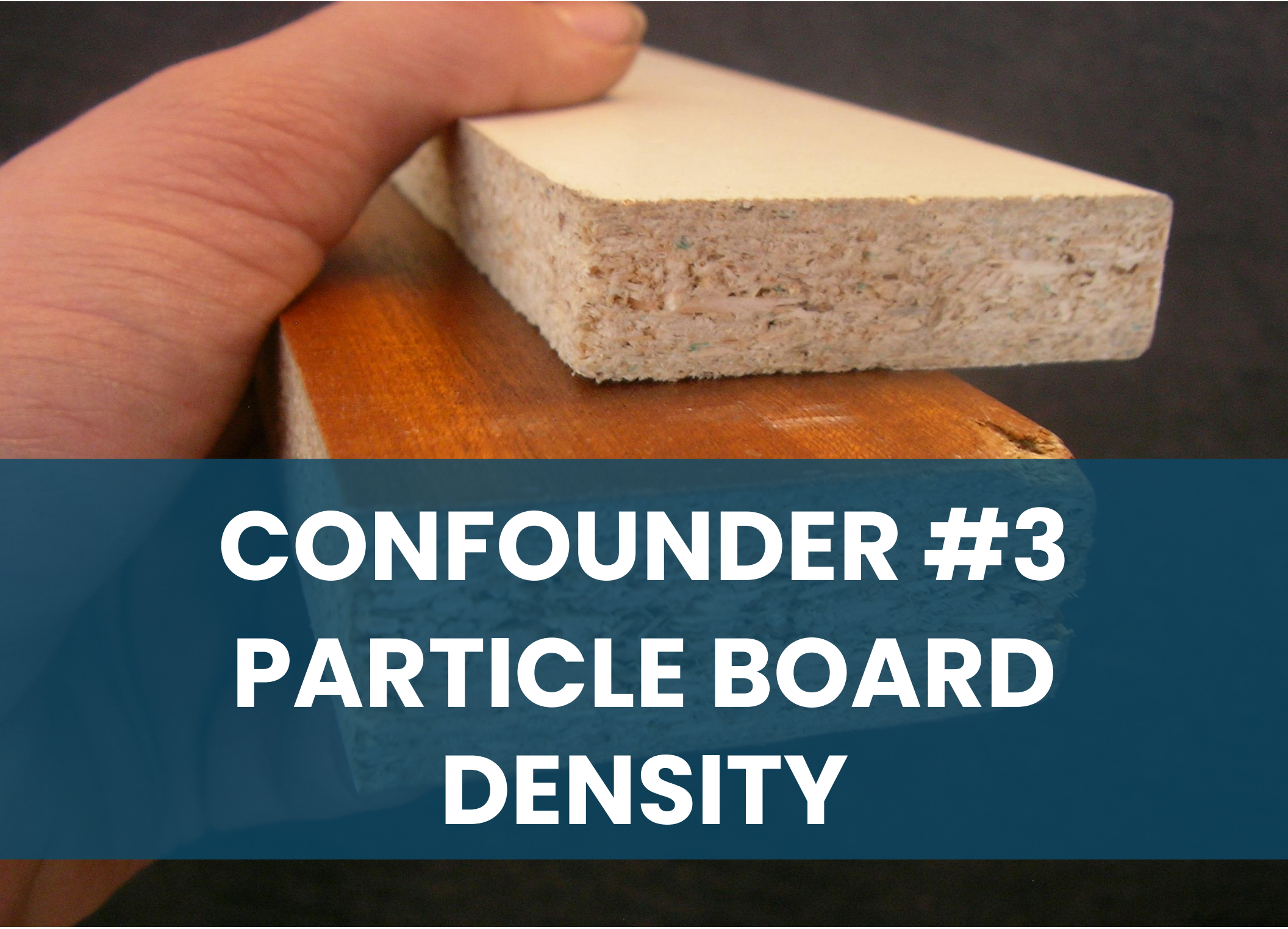
For One Time, Continuous Water Event

- An experiment based on continuous water exposure for 60-100+ days is not applicable to usual real world events.

Conclusion: Not Peer Reviewed.

Compares Apples to Oranges.

Not Science. Not suitable for use in claim denial.



CONFOUNDER #3 PARTICLE BOARD DENSITY

5/8” Melamine Experiments

“The physical and mechanical properties particleboard grades use a three integer system (i.e, 2-H-2) where the first number corresponds to the adhesive (Type 1 or 2), the second letter corresponds to the density as an “H” (high, 50 pounds per cubic foot (lb/ft^3, “M” (medium, 40-50 lbs/f^3 and “L”(low, less than 40 lb/ft^3) at 7% wood moisture content. The third number signifies the stiffness (1,2 or 3) as specified by ANSI Standard A208.1”

5/8 Melamine coated particle board is the common material for most cabinet boxes and featured in Moon’s study.

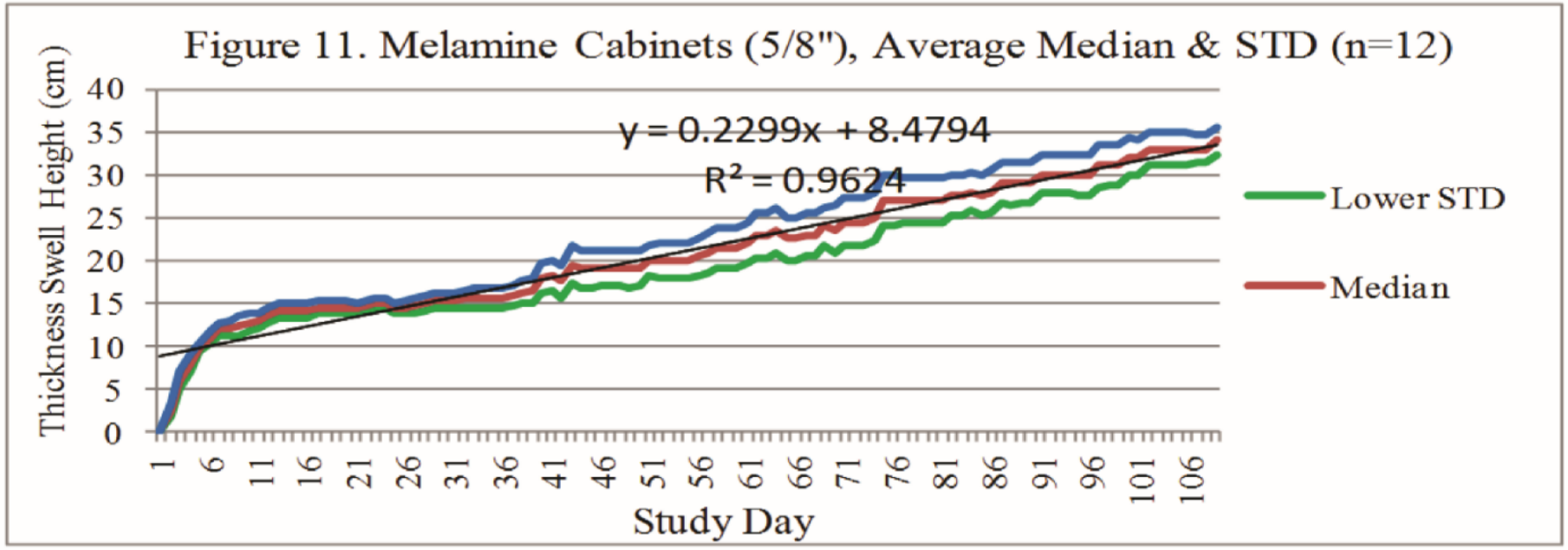
Particle board is specified in the industry with three characteristics: Adhesive, **Density**, Stiffness.

5/8” Melamine Experiments

The data indicated that high density particle board will absorb moisture slower than low density particle board.

- Per Moon: Density of the particle board has a major effect on the rate of TS (Thickness Swell) Height.
- Makes sense. Particle board that is dense and more like wood, swells less. Particle board that is mushy and more like cardboard, swells significantly more/faster.

5/8 Melamine Figure 11.



- Moon experiment Fig 11: Put Melamine covered cabinet sides in water and measure TS (Thickness Swell) height over 110 day period.
- Then develop an equation from the data that Moon uses to determine: Duration of water exposure of insured cabinets **assuming like conditions which means assuming at a minimum similar densities.**

Density Impacts TS Height

Because particle board **density** plays an important role in the rate of expansion…

One MUST make sure that the particle board in the insured kitchen is the same density as that used in the experiments …

However that is generally not possible as it requires destroying the kitchen cabinets to determine the particle board density.

Davis/Moon: Measuring Density

Particle board sections (10" x 2.4") were cut from nine specimens, dried to 7-8% WME in an oven at 170°F, weight and linear dimensions measured using a micrometer (Westward) for comparison to swelling height result obtained at 14, 28, 48 and 60 days.

- According to Moon, to calculate density, one must cut a piece of the insured's cabinet side at a specified size; dry it; and then in a lab weigh it to calculate density.

However, determining the insured's cabinet density is impossible to do in practice, because this requires the destruction of the cabinet. So its never done.

Density Impacts TS Height

- So one can **never know** the density of the insured cabinets.

Because density varies and Moon's equations are based on a particular density it is impossible to reliably calculate leak duration from TS height based on Moon's work.

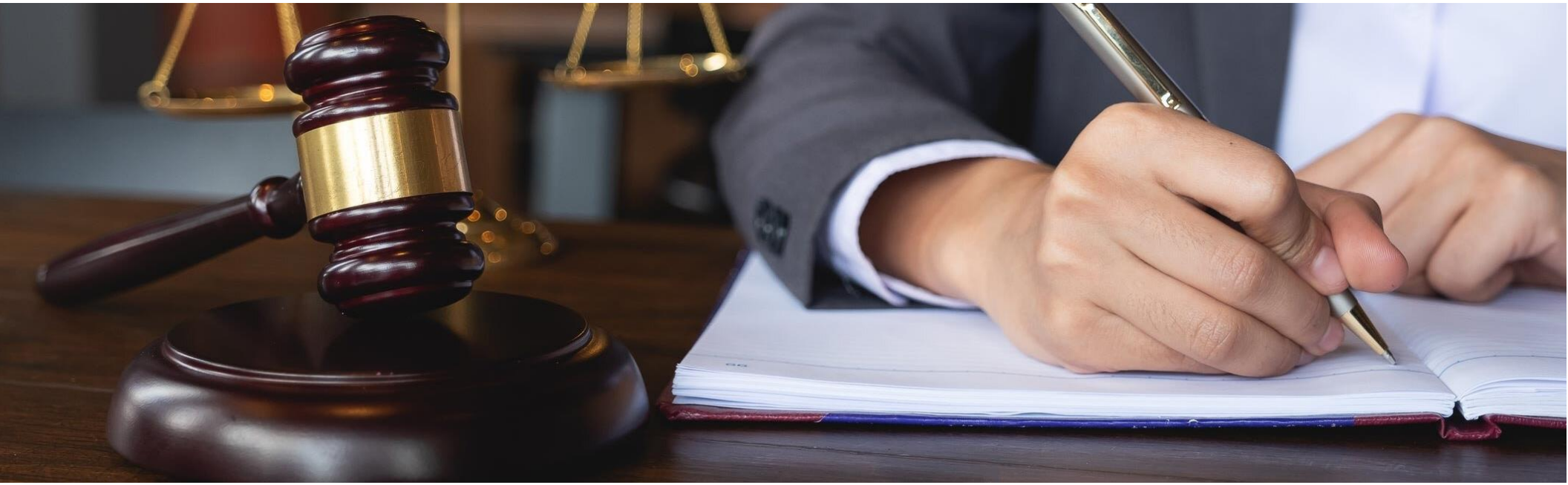
Yet Carriers are using Moon 2015 to deny claims.

If You Attempt to Bring Up These Issues …

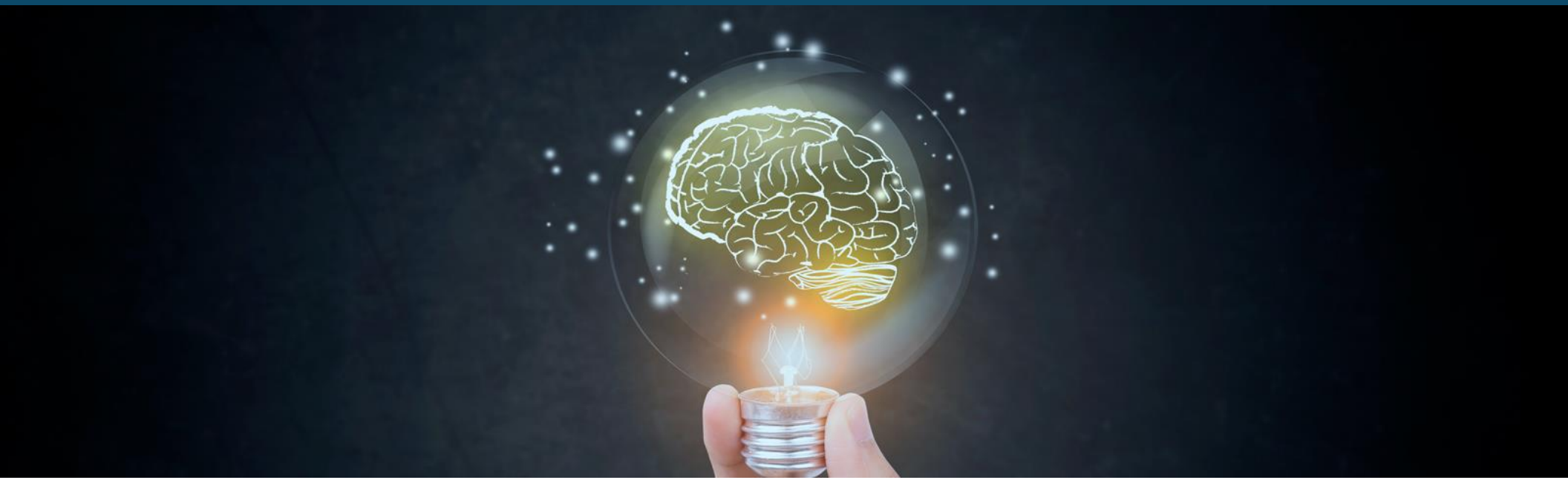
The opposing attorney does not have either the time, patience, or background to get "bogged down" in detail.

The facts are according to Defense Attorney that Moon's study was Peer Reviewed and your comments/ challenges were not.

Therefore your comments/challenges are irrelevant.



CONFOUNDER #4 UNKNOWN MATERIAL IMPOSSIBLE TO REPEAT STUDY



Unknown Material

Studies Cannot be Repeated

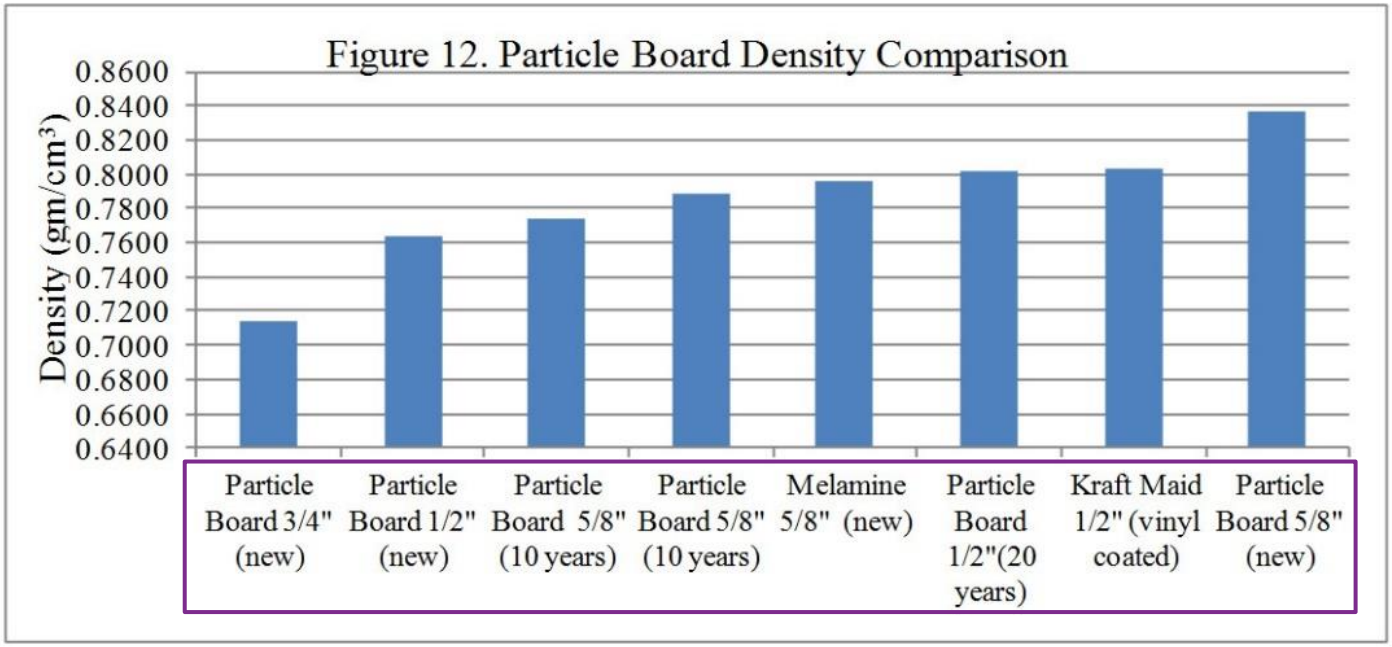
Test Study: Vinyl and Melamine Coatings

"Two Parallel studies were conducted using vinyl and melamine-coated cabinets. Four (4) vinyl-faced particleboard cabinets (Martha Stewart (1/2" panel) sides, Kraft Maid (1/2" panel sides), American Woodmark (1/2" panel sides), Thomasville (1/2"), 34"x 9" x22" and two (5/8" panel sides) melamine-faced cabinets boxes (34" x 36"x22") were used. The cabinets were placed in the test chambers under the conditions as described above and exposed to a continuous source of moisture for 109 days (vinyl) and 138 days (Melamine)."

- 2 - 5/8" side panels. But no mention at all about the brand/source of material. Impossible to repeat this experiment.
- So what is the scientific basis of this experiment?
- None. Because there is no indication of what material was used. Can't repeat. Not science.

Unknown Material

Studies Cannot be Repeated



- In most cases Moon does not provide information as to the brand of particle board used.
- Impossible for others to repeat this experiment.
- Not only is it impossible for others to repeat Moon's experiments, but many or most of the experiments as published were not repeated by Moon.
- Only performed once. Not science.

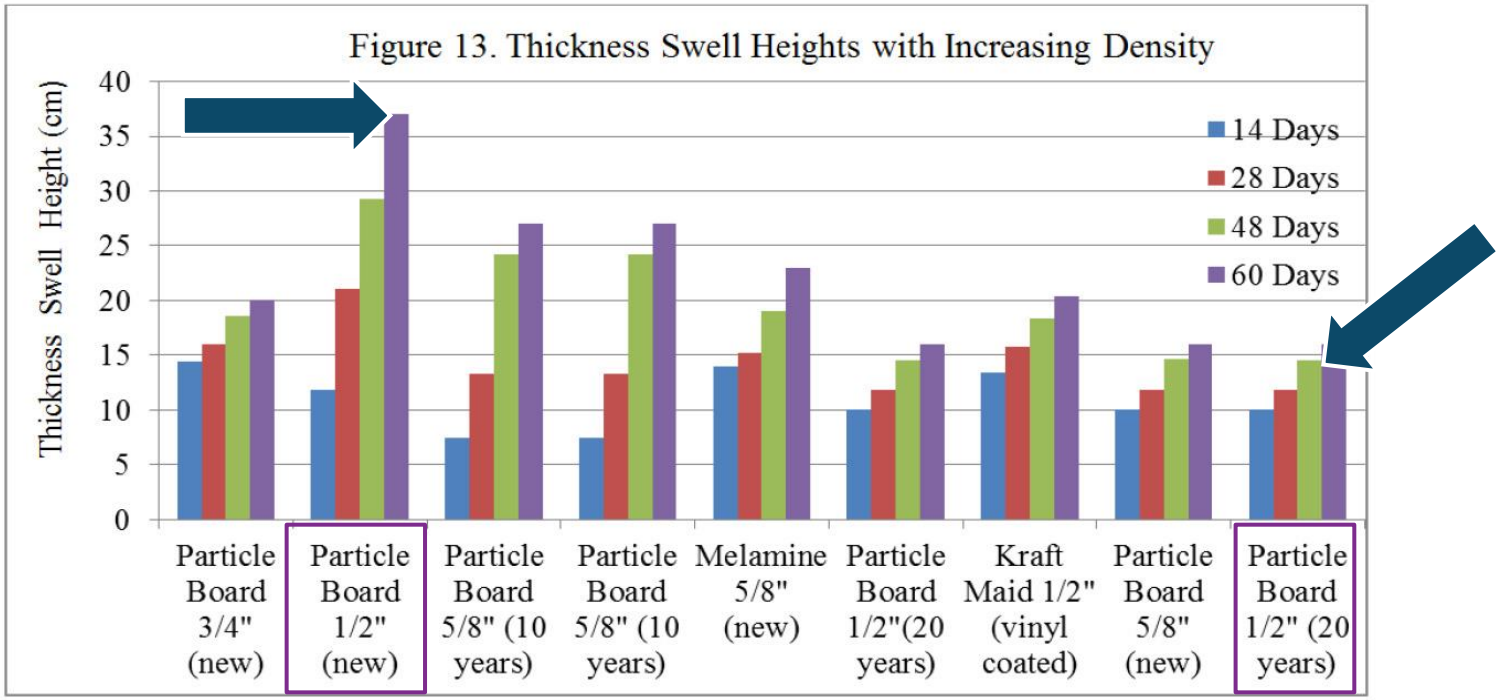
Moon Density Studies

Experiments in Moon have not been repeated. Not science.

Experiments in Moon do not have enough detail to allow others to repeat. Not science.

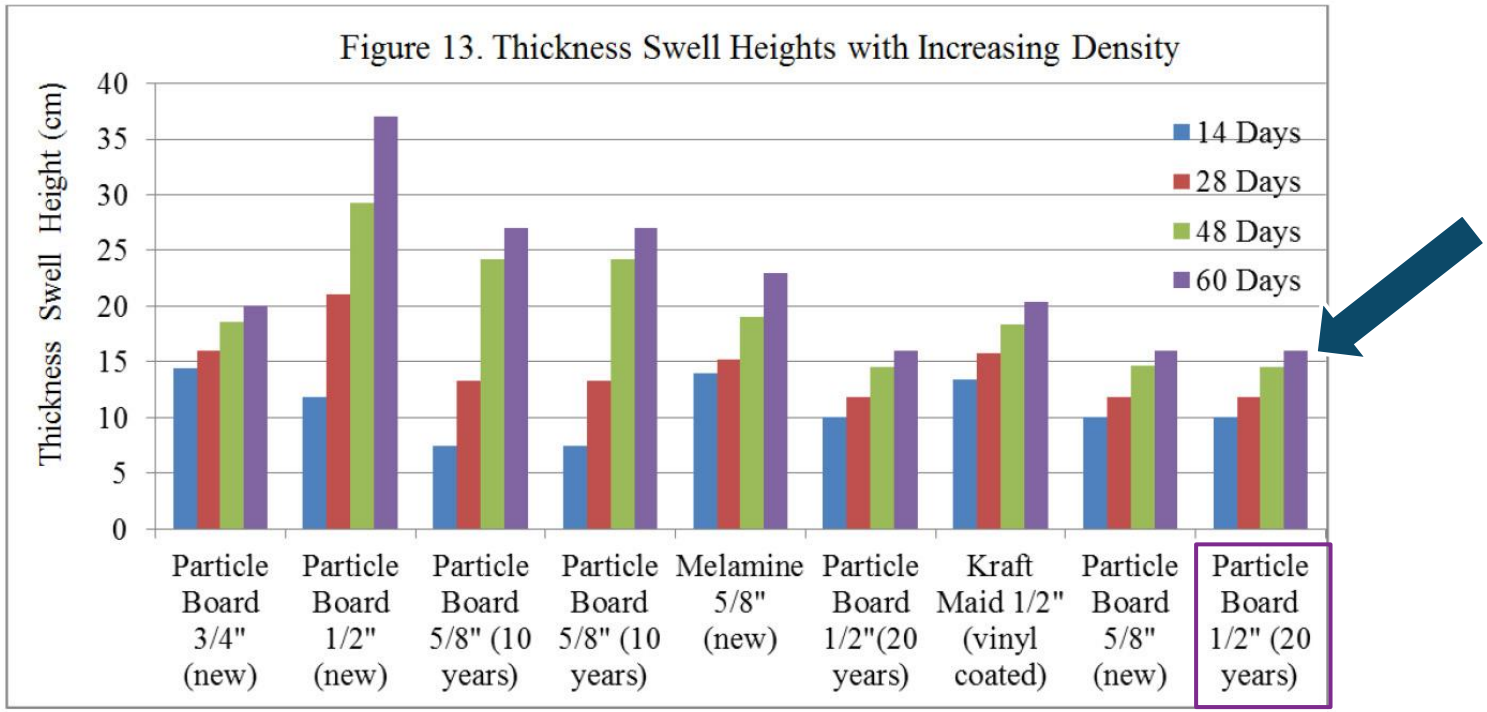
CONFOUNDER #5
PARTICLE BOARD AGE

Age Impacts TS Height



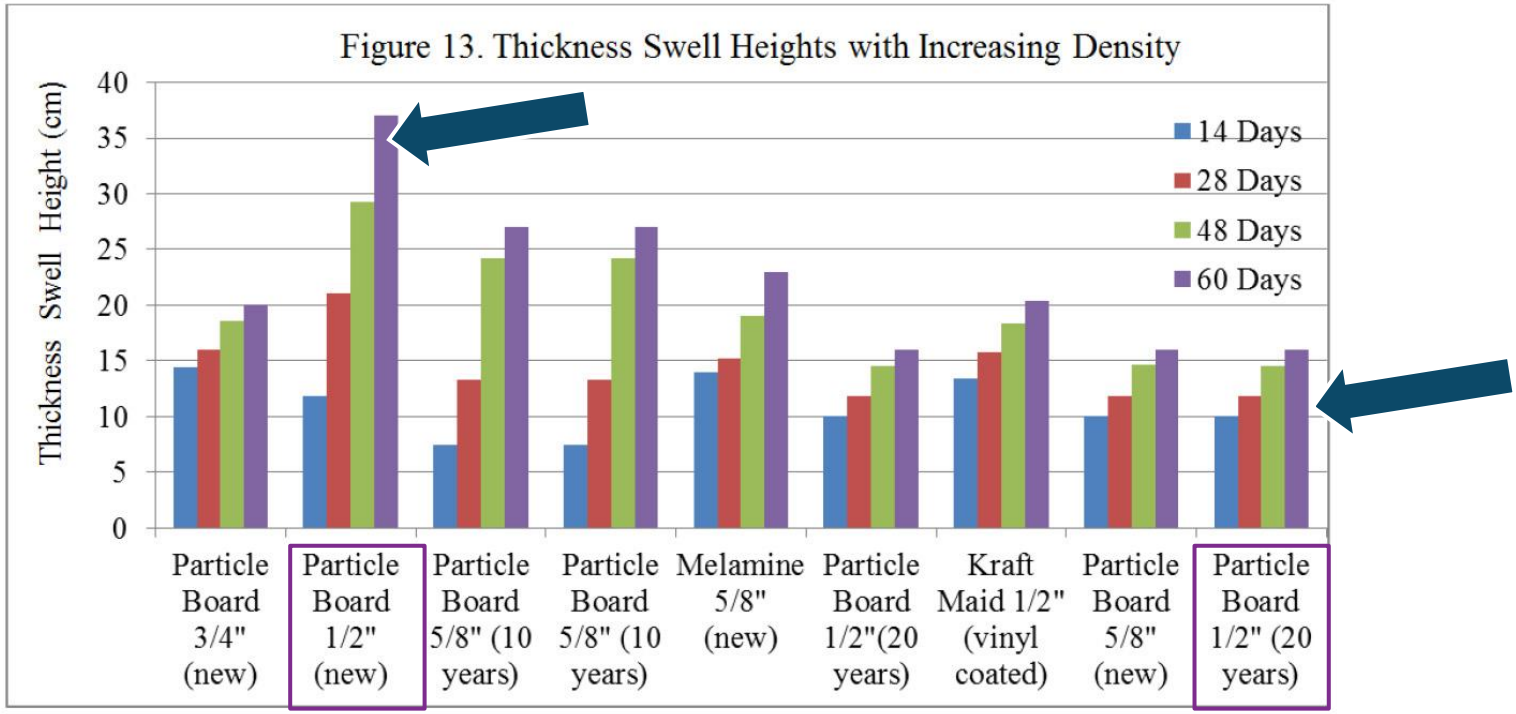
- Moon fails to discuss it in his article, but it is very clear from his data that the age of the particle board has a very significant affect on TS height. See below.
- In Moon's Fig 13, Moon shows that there can be a 2x difference in the rate of TS based on the age of the particle board.
- This is massive. But Moon never knows for sure the age of the insured cabinets. Apples to Oranges.

Age Impacts TS Height



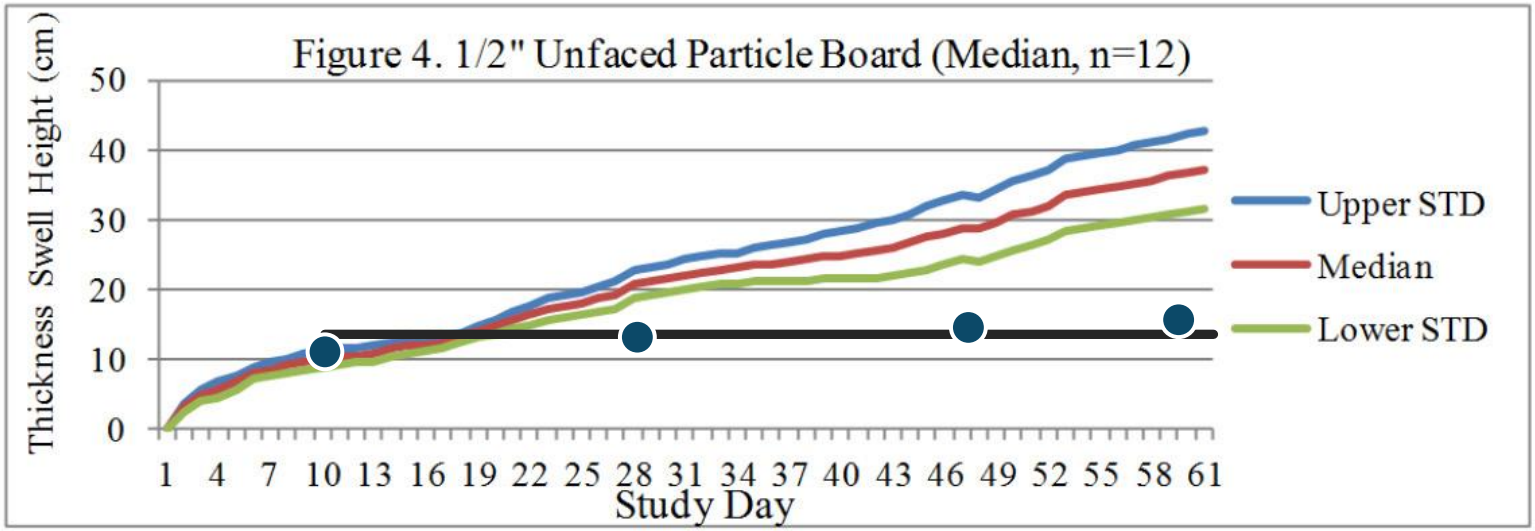
- Let's take a look at Moon's data for 20 year old ½" particle board. See below.
- 14 days = 10 cm; 28 days = 12 cm; 48 days = 14 cm; 60 days = 16 cm

Age Impacts TS Height



- Let's take a look at Moon's data for 20 year old ½" particle board. And compare it to ½" new particle board.

Age Impacts TS Height



- Lets put the 20 year old data points (14 days = 10 cm; 28 days = 12 cm; 48 days = 14 cm; 60 days = 16 cm) onto Moon's Fig 4 plot of the ½" new.
- The older particle board (●) shows NO SIGNIFICANT increase in TS height after the first 14 days.
- Since older particle board has NO significant increase in TS height after the first 14 days.
- And since rarely are kitchen cabinets brand new.
- Moon's theory that you can measure TS swell and determine water loss duration has No Merit.

CONFOUNDER #6 COATINGS DO NOT IMPACT TS

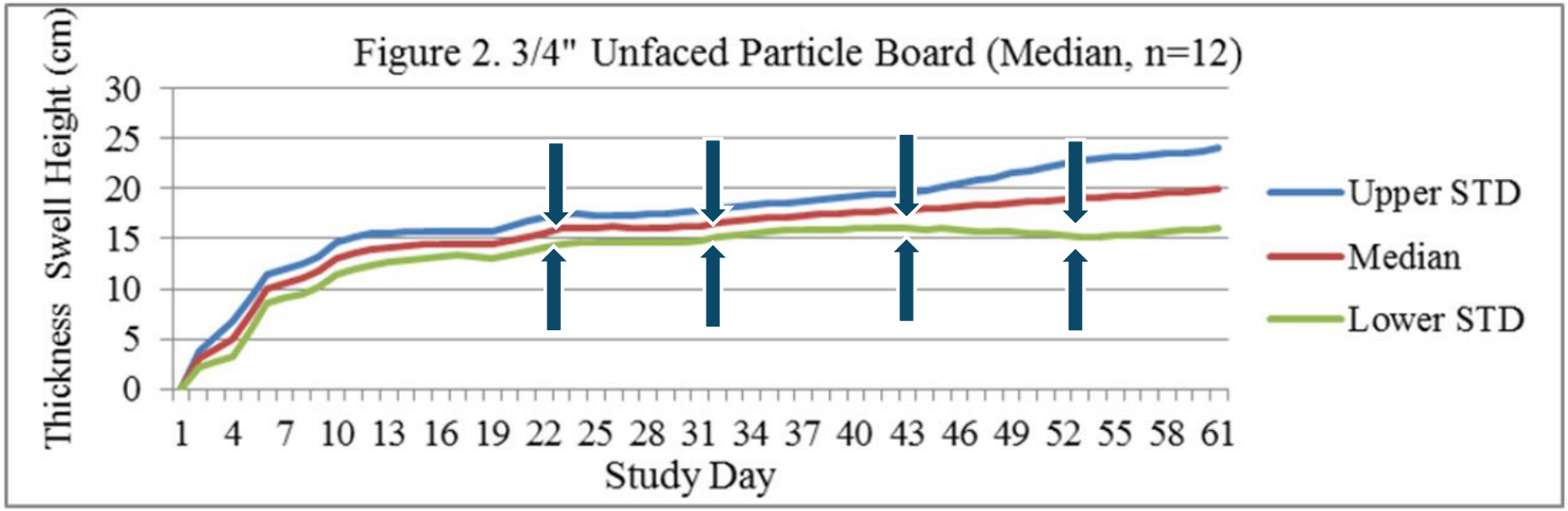
Per Moon: Coatings Have No Impact on TS

"Faced vs Unfaced Panel Coatings: A TS comparison made between (1/2") particle board panels covered with a 6 mil polyethylene coating showed **no statistical difference between coated and uncoated panels** (Figure 6)".

"Panel coatings (polyethylene, vinyl, melamine or none) had **no appreciable** influence on TS under the humid conditions (>90%RH) examined."

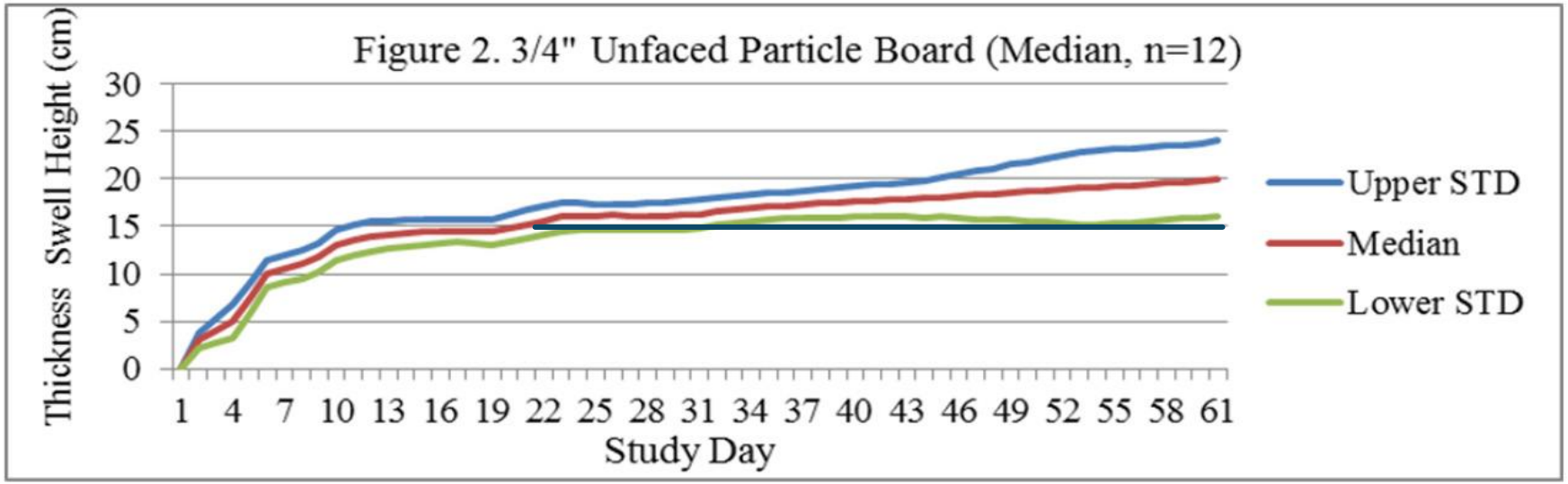
- Moon says: **Coatings have no impact on TS.**

Unfaced. No Statistical Change



- The lower STD line is the same between Day 23 (or so) and day 54 (or so.)
- This means that within the error bounds of Fig 2, there is NO increase in TS over time for ¾" Unfaced Particle Board.

Conclusions: No Statistical Change.



- No statistically meaningful difference after 23 days.
- Per Moon: No difference between coated and not coated.
- That means that per Moon: **ANY graph of particle board swell, no matter what the facing, should be statistically equivalent if the same thickness.**

Reviewing Moon's Theory

Moon's theory is

That TS height increases over time based on duration of water exposure in a linear fashion;

That the increase is predictable and can be used to accurately determine water loss duration for water damaged kitchens.

That TS height is independent of coating.

Reviewing Moon's Theory Main Assumption

Moon is assuming a linear behavior.

There is no science presented to decide that a linear relationship is appropriate or should be preferred over any other kind of curve.

A linear curve ignores the initial period of time and a polynomial regression (non-linear line fit) or logarithmic regression would be recommended.

Moon's Theory Has No Merit

- Moon's Fig 2 shows no statistically relevant TS height increase over time (beyond the 10-14 day first spike).
- Since per Moon coating does not affect TS height, Fig 2 applies to all ¾" cabinets independent of facing.
- Moon's theory has NO MERIT when applied to uncoated or coated ¾ inch particle board. There is no significant increase in TS height after 14 days!
- If there is no correlation between ¾" cabinet TS height and water duration…
- There is no reason to believe that this would be any different for ½" or 5/8".
- Keep in mind that the Moon experiments are all "one off". Never repeated.
- NOT Science! Yet they are being used by Carriers to deny claims.

CONFOUNDER #7 PARTICLE BOARD THICKNESS

Particle Board Thickness

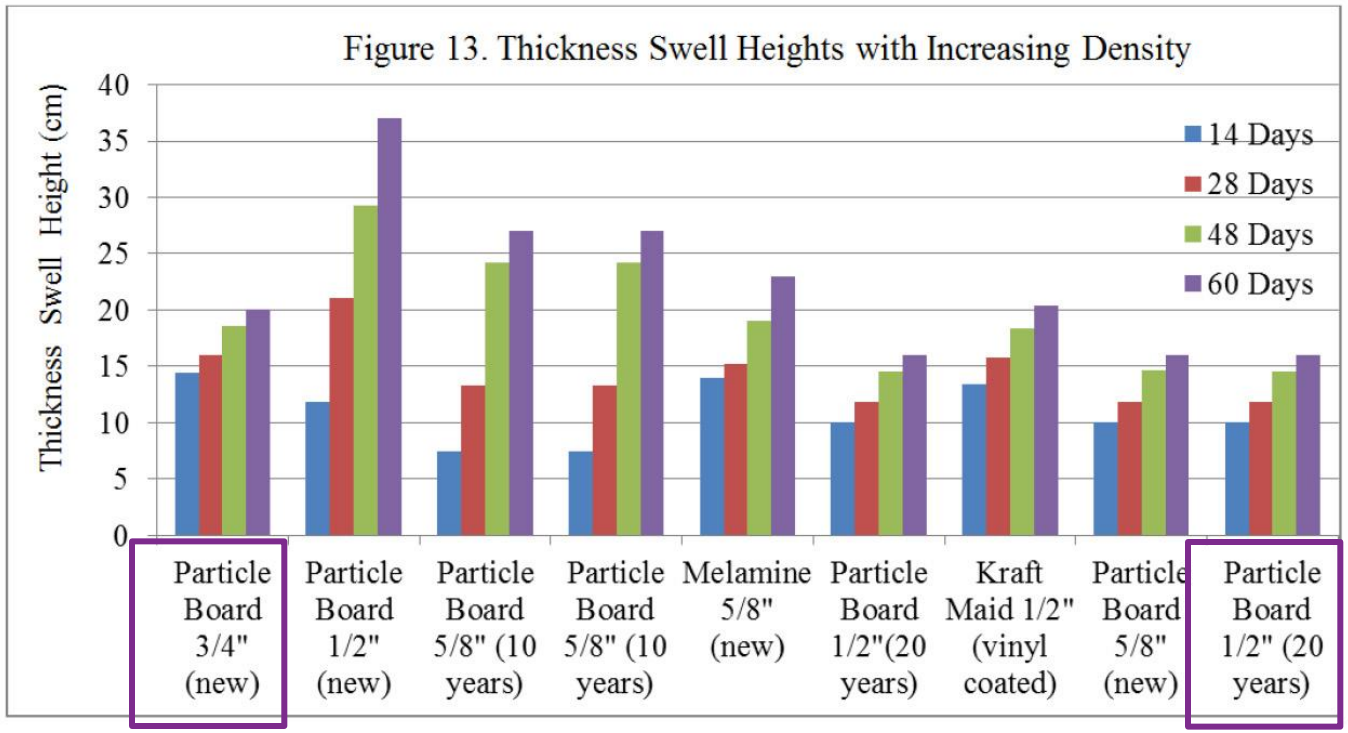
"Absorption for a period of approximately 12 days followed by a slower, linear rate that continued for several months. Examination of the median and standard deviation values showed that TS rates for 1/2", 5/8" and 3/4" exhibited overlapping ranges during the first 12 days; however, TS rates thereafter appear to differentiate based on thickness with the 1/2" panel migrating the fastest."

Per Moon conclusion, the TS rates are fastest with thin panels.

Slower with thick panels.

Particle Board Thickness Anomaly

- But in his Fig 13, TS is much faster for ¾" particle board than ½" particle board.
- This says that Moon's conclusion on the previous page is wrong.



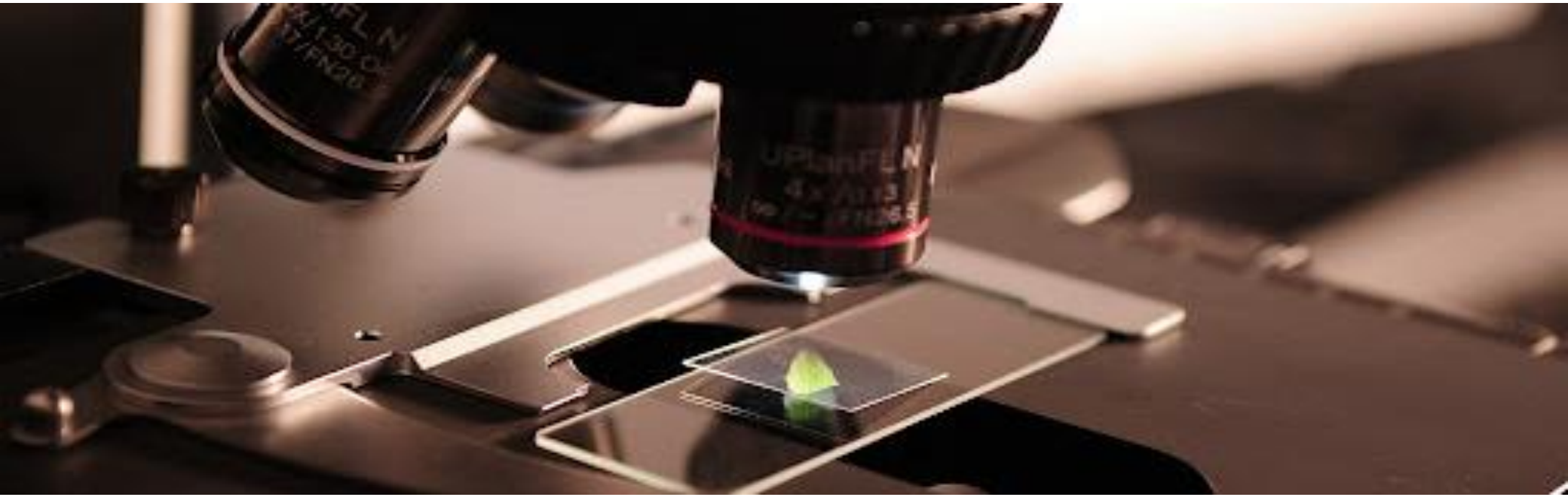
¾" Particle Board "Anomaly"

"The lower density expressed for 3/4" particle board in Figure 12 is explained by the large portion of low density inner core materials used for thicker panels. Using 3/4" particle board, the outer layers were separated from the central core so that the volume and weight of each layer could be measured for density **(Photo 3)."**

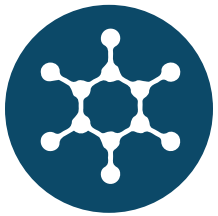
- Moon then investigates what is happening with the ¾" particle board. Why so fast to swell?
- Why is the ¾" rate of swell so much faster than the rate of ½" when thicker particle board generally swells slower than thinner per Moon?
- His answer (he postulates) is that the ¾" panel is **low density** particle board.

Many Factors Impact TS

- To really examine the factors of density and thickness, further statistical testing must be done to consider the interactions between these factors.
- Moon's level of detail is not able to meet scientific scrutiny.



¾" Anomaly Caused by Density

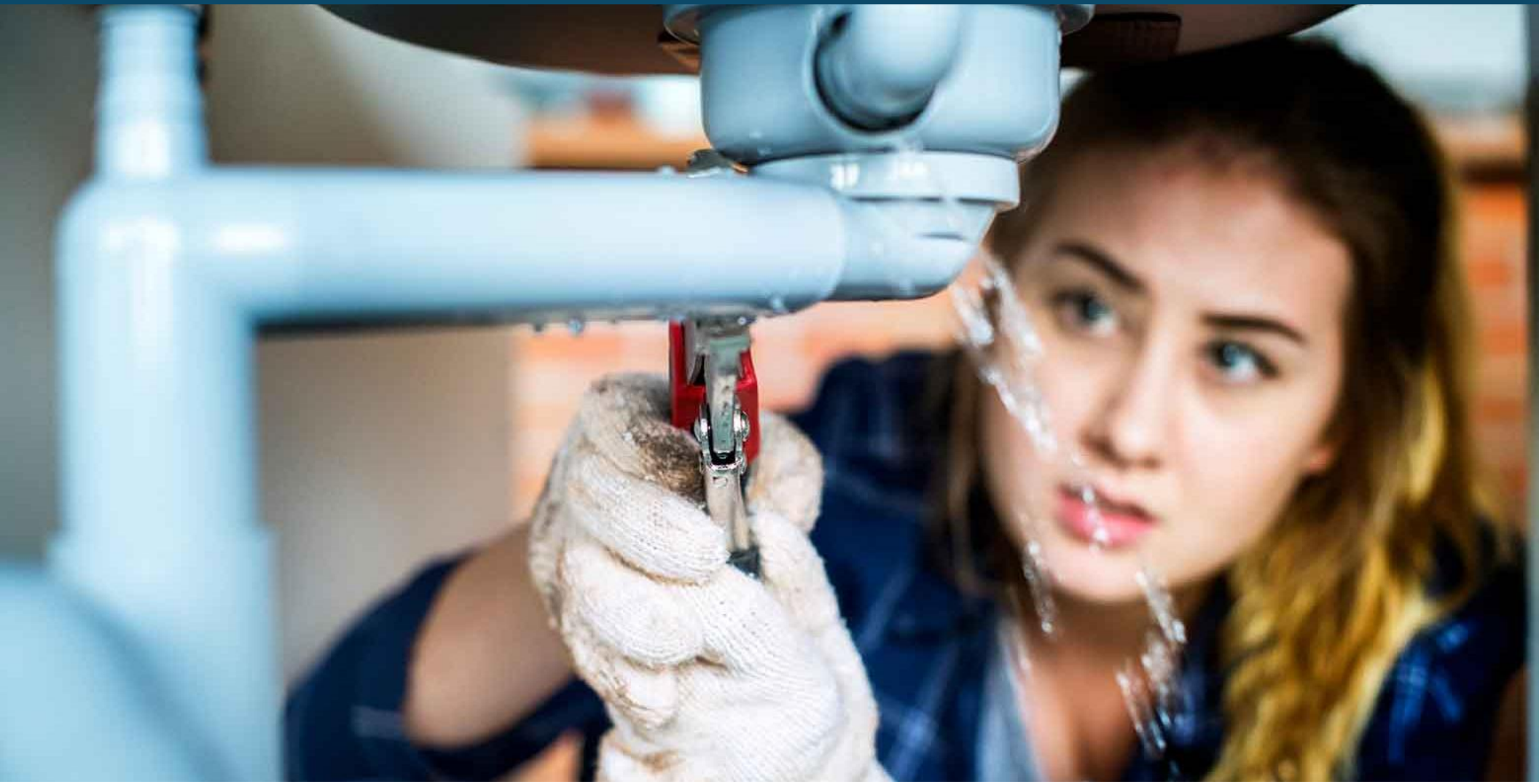


Density here accounts for a massive difference in TS rates more so than the particle board thickness.

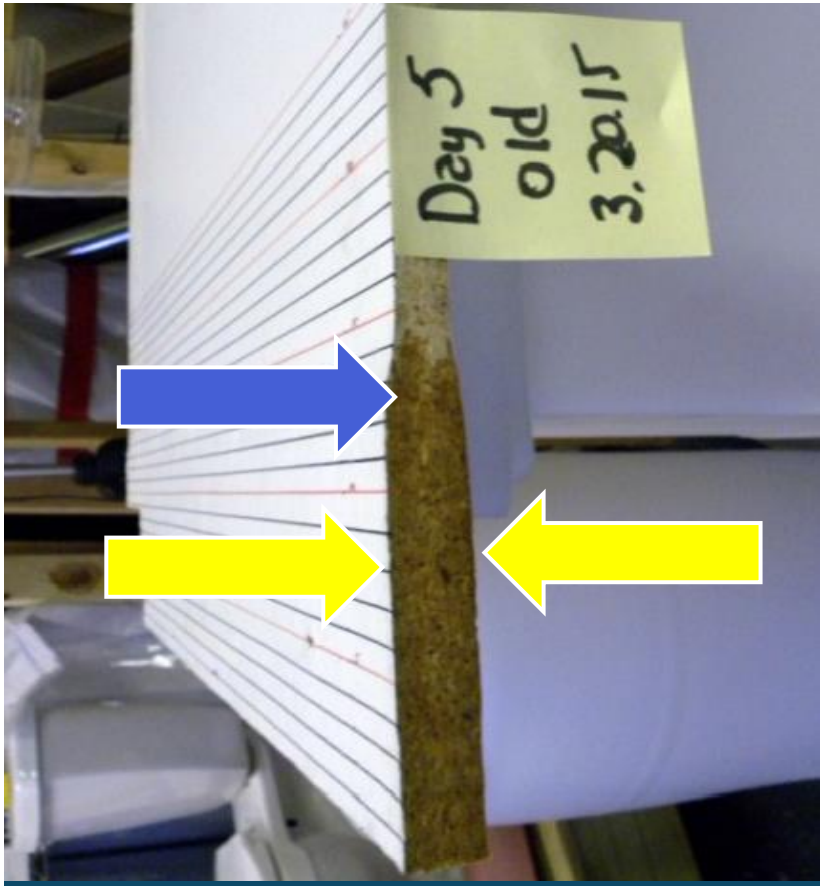
But Moon can never know the density of the insured cabinets because that requires destroying the cabinets which is not permitted.

However, in spite of not being able to ever know the density of the insured cabinets **Moon applies his proprietary "theory" to deny claims.**

THE MISSING 14 DAY CONTROL



Swelling Effects Massive After Only 5 Days



Moon Photo 1. Thickness swell is apparent after 5 days of continuous moisture exposure as identified by both sight feel.

- Here Moon shows swelling of approximately 2x the width after only 5 days of exposure to water (yellow arrows.)
- TS (thickness swell) height at 3.2". (Blue arrow)
- Swelling effects massive after only 5 days.

Water Exposure Constant

"The cabinets were placed in the test chambers under the conditions as described above and exposed to a continuous source of moisture for 109 days (vinyl) and 138 days (Mealmine)."

One of the biggest problems with the Moon study is the lack of suitable controls.

Moon is trying to prove the length of time of water exposure based on thickness swell (TS) of particle board by immersing in water continuously for months.

Water Exposure Constant or Stopping at 14 Days

- But what we don't know from his experiment because there is no control is....
  - What about the situation where there is 13 days of water exposure or less and then the water stops but the particle board is not dried out?
  - Does the particle board continue to swell when the leak is stopped at or before day 14 but the particle board is not professionally dried out?

Timing of Damage During The First 13 days

- Using the data from this study to predict what would happen to short term leaks is an incorrect use of this study data.
- This question as to the timing of permanent damage during the first 13 days was not explored in the Moon 2015 study.

Water Exposure Constant or Stopping at 14 Days

- We know particle board dries slowly especially coated on both sides (by Melamine or Vinyl). IICRC calls this a Class 4 material. Slowest to dry.
- Surely water saturated particle board cabinet panels will continue to expand for weeks or months without new exposure to water.
- Moon's experiment only measures expansion with continuous water exposure for months. Lacking controls.

Water Exposure Constant or Stopping at 14 Days

Due to lack of an experimental control at 14 days, there is:

No way to determine if the TS is the result of an ongoing leak (a long-term leak) or;

From residual wetness in the particle board cabinet side panels causing continued TS expansion.

Yet Moon's publication is being used to deny claims based on TS height measurements "proving" long term leak.

Cabinets On Concrete Slab

- Furthermore, most kitchen cabinets are installed directly onto the concrete slab.
- The concrete slab quickly absorbs moisture but releases it very slowly. It is also an IICRC Class 4 material … slowest Class of material to dry.
- Again, what about the situation where there is 13 days of water exposure and then the water stops but the particle board cabinet side panels and concrete under it are not dried out?
- Surely the still wet particle board on wet concrete slab will continue to expand for weeks or months even though the leak has stopped by 13 days.
- So the expansion of the particle board after day 13 would not correlate with the duration of the water leak.

Yet Moon's publication is being used to deny claims based on TS height measurements "proving" long term leak.

No Proper Control

- No way to determine if the Thickness Swelling of the particle board is a measure of ongoing, continuous moisture (> 13 days) or residual moisture in the particle board cabinet panels and/or wet concrete slab.

Without the proper controls the Moon study is NOT Science. No Merit.

Yet Moon's publication is being used to deny claims based on TS height measurements.

Short Term Loss. Trapped Moisture.

Or for that matter from a pool of water trapped for weeks or months under the cabinets in an indentation (pocket) below the cabinets surrounded by tile flooring and tile toe kicks.

Water can be trapped under here for weeks or months after a short-term leak. Not detected but causing continue swelling to bottoms of cabinet panel sides.

No Peer Review

- The fact that Moon does not have adequate controls such as determining how much expansion there is if the water does not continue after 13 days but the cabinets or environment are not dried out …

Means that either there was no Peer Review or the reviewers were not experts in the subject matter (few are).

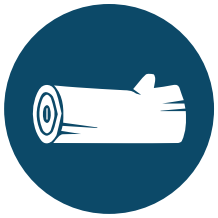
Moon 2015 was not professionally Peer Reviewed by careful, competent reviewers.

Per Moon: Damage is Massive & Irreversible by 5 Days

Saturated With Water 3.2” High After 5 Days

- Moon Figure 1: At 5 days of exposure to water, moisture is trapped between two layers of melamine facing.
- TS height is 3.2”.
- According to Moon, the loss is irreversible.

Fiber Saturation Point (FSP) Definition



FSP is the moisture content when the wood cell walls are full of water and swelling of the material ceases.

FSP is NOT a fixed value that we know and varies with the individual wood species.

FSP is used for solid wood and not particle board.

NOTE: Wood fiber sources typically used for particleboard may come from various species with little to no documentation provided by manufacturers. And unknown variable NOT considered by Moon.

Moon's Improper Use of FSP

"When composite wood products absorb moisture beyond the FSP, the swelling effects are irreversible. This characteristic allows the forensic engineer to examine particles."

- FSP is used for solid wood.
- There is no requirement that thickness swell has to wait for FSP.

Damage Is Irreversible per Moon

"When composite wood products absorb moisture beyond the FSP, the swelling effects are **irreversible.** This characteristic allows the forensic engineer to examine particles."

Irreversible means that even years later one can measure the TS.

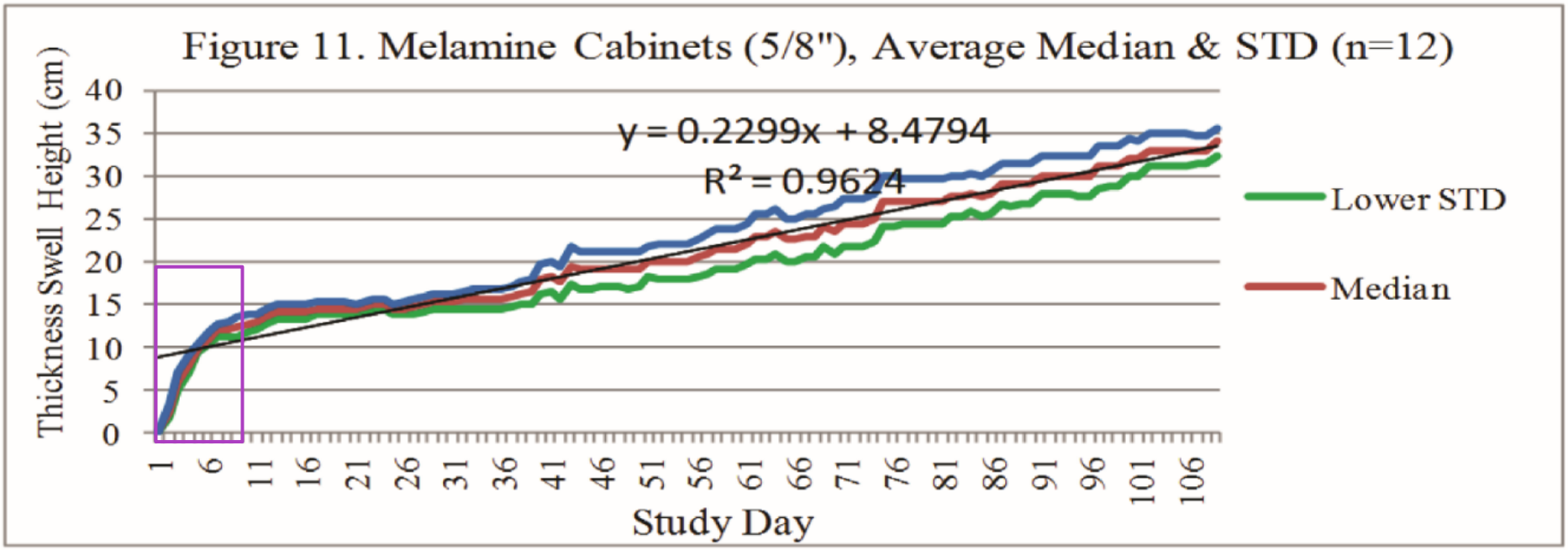
But irreversible also means that cabinets cannot be restored to pre-loss condition.

Do swollen cabinet bottoms that cannot be restored to pre-loss condition require replacement?

IICRC on Cat 3 Water Exposed Particle Board. Replace.

- If particle board is exposed to clean water and is swollen [irreversibly], IICRC S500-2015 does not provide any guidance.
- However if water has changed to Cat 2/3 and particle board is contaminated, IICRC requires that the cabinets be discarded.

Short Term Massive, Irreversible Damage to Particle Board.



- Massive, irreversible damage occurs during the first 13 days of water exposure.
- What happens afterwards is of no consequence for an insurance claims.

IICRC on Cat 3 Water Exposed Particle Board. Replace.

- One of the controls missing from Moon is exposing coated particle board to moisture for let's say 5 days as in Davis Fig 1 on the right…
- Stopping the water (at Day 5) and determining if the cabinets are salvageable or will the bottoms be covered in mold and must be discarded per IICRC by Day 14.
- Of course, since the EPA says mold starts to grow in 48-72 hours we already know the answer. Discard.

IICRC on Water Exposed Particle Board.

- With water trapped between two sides of melamine above, there will always be a Cat 3 loss because it will never dry without professional dry-out before mold has a chance to grow.
- The Carrier policy language typically stipulates that if the water leak went on for greater than 14 days, the leak is long term. Deny coverage.

IICRC on Water Exposed Particle Board.

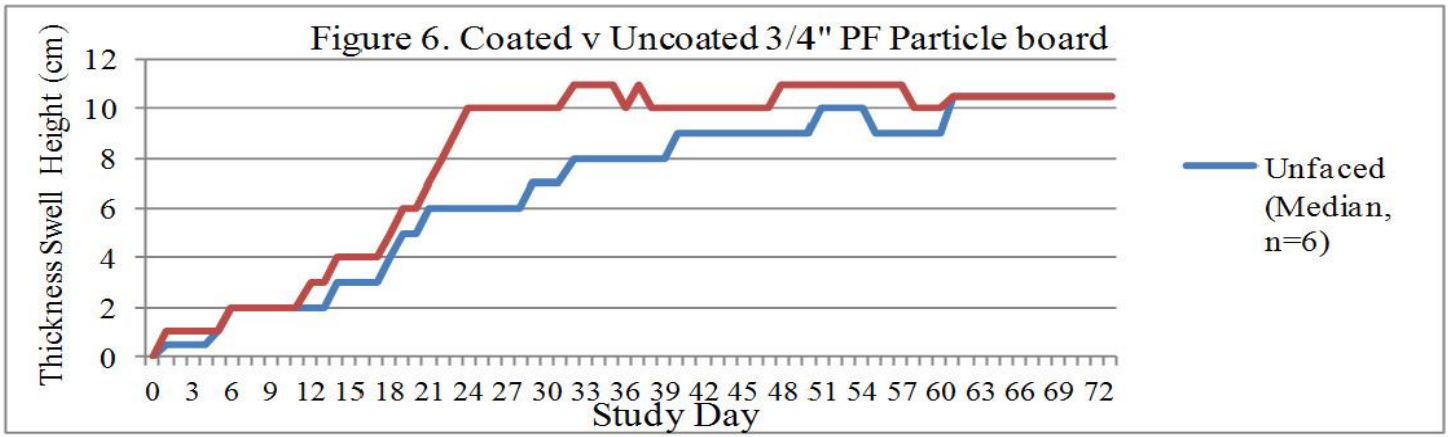
- IICRC S500 does not say that residual moisture must be dried by day 14.
- Nothing about timing in S500. If there is mold or if there is permanent swelling or delamination remove/ replace. Do not dry.

Yet Moon 2015 is being used to deny claims without having this important control to determine if the TS was the result of residual water trapped between the particle board coating after day 14.

A Myriad of Errors in Moon Figures and Charts

Coated vs Uncoated The Same?

Faced v Unfaced Panel Coatings: A TS comparison made between (1/2") particle board panels covered with a 6 mil polyethylene coating showed no statistical difference between coated and uncoated panels (**Figure 6**).

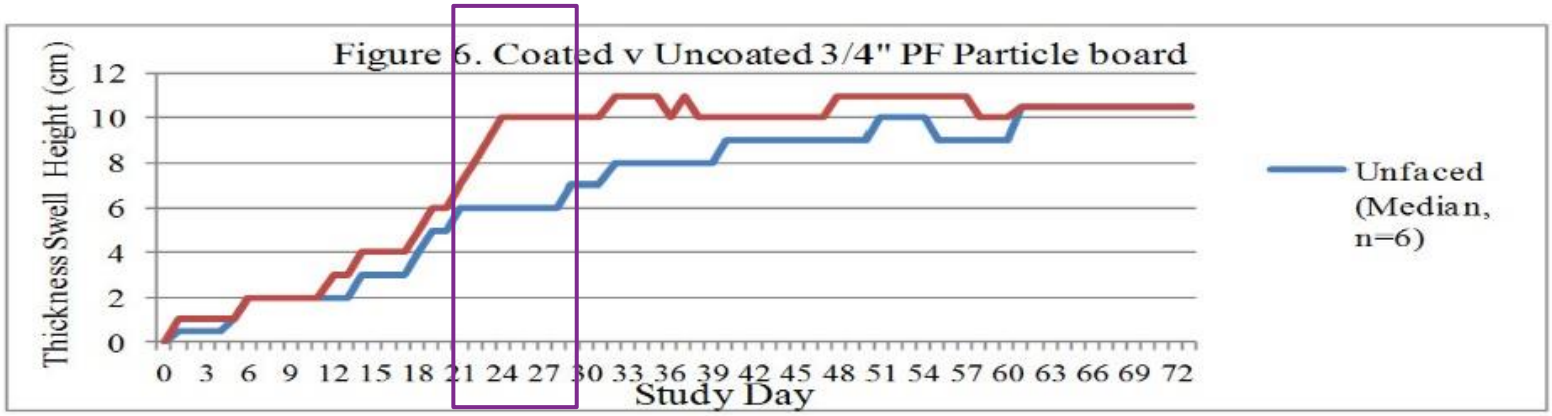


- Fig. 6 Moon states that these two graphs are "the same". That Coated vs Un-Coated Particle board expands the same.

That statement makes absolutely no sense. It is an error. Not Peer Reviewed. These graphs are not the same!

Coated vs Uncoated The Same?

Faced v Unfaced Panel Coatings: A TS comparison made between (1/2") particle board panels covered with a 6 mil polyethylene coating showed no statistical difference between coated and uncoated panels (**Figure 6**).

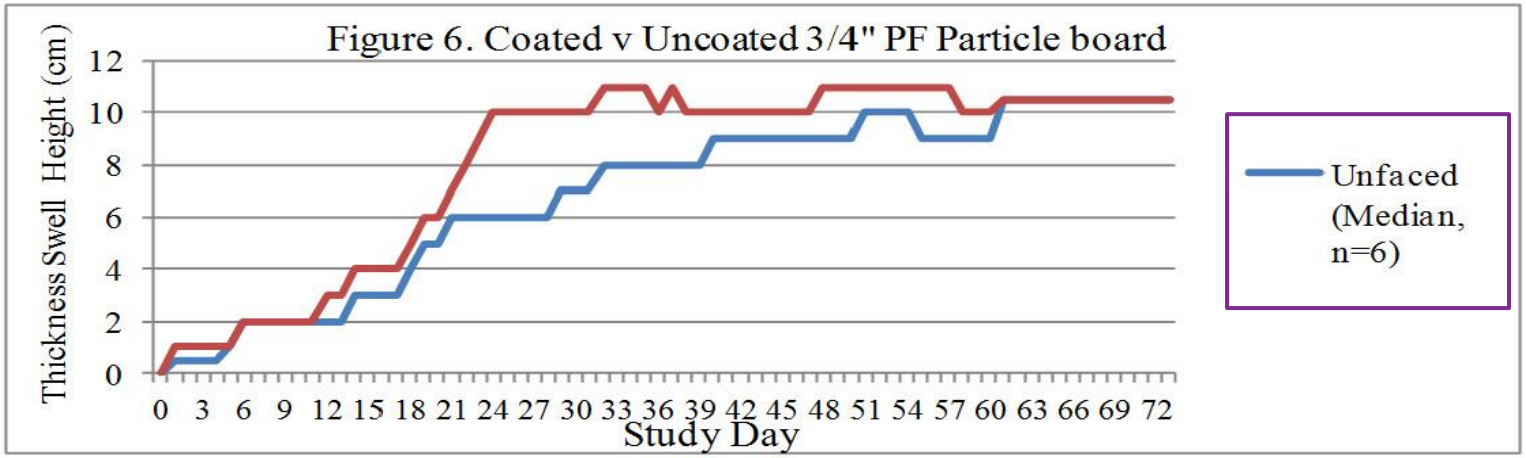


- "Statistically equivalent" means that when you account for normal experimental variation, a TS height of 6 cm at day 24 is no different than a height of 10 cm on day 24 even though one is 60% of the other!

No competent reviewer would permit a statement saying these two graphs are statistically the same.

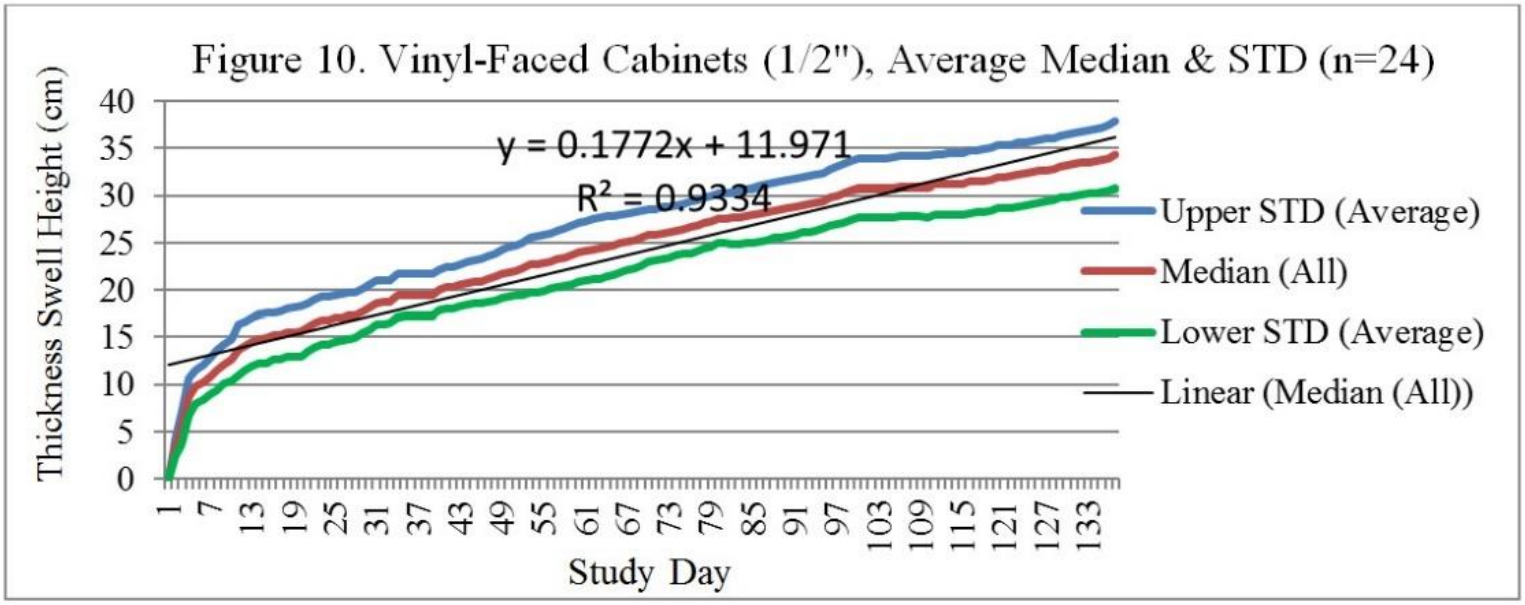
Typo in Fig 6

Faced v Unfaced Panel Coatings: A TS comparison made between (1/2") particle board panels covered with a 6 mil polyethylene coating showed no statistical difference between coated and uncoated panels (**Figure 6**).



- There is no legend for the red line which is faced panel.
- Even the least sophisticated reviewer would find these types of problems. And there are so many of them.
- **Not Peer Reviewed.**

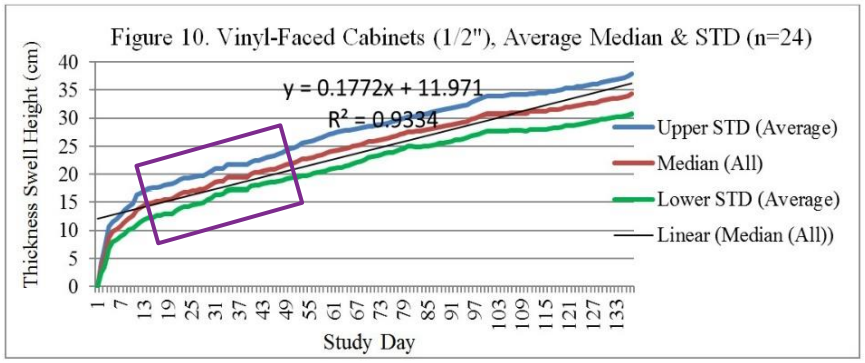
Another Error

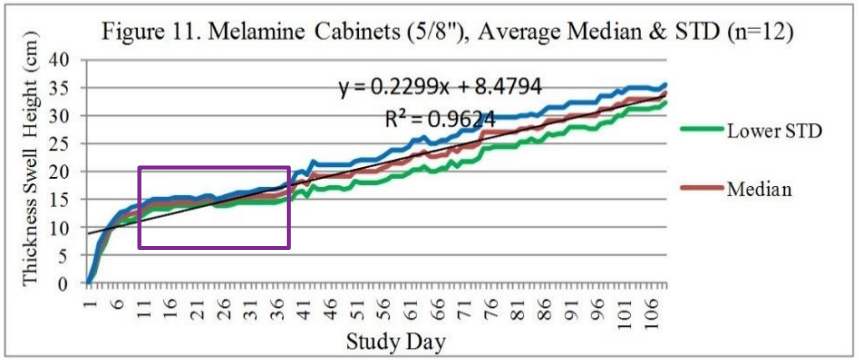


The melamine cabinets expressed the same accelerated TS rate during the first 12 days and linear rate thereafter as did the vinyl cabinets (**Figure 11**). A comparison between the vinyl (1/2") and melamine (5/8") TS rates shows that they are similar.

- Moon says under Fig 10: "vinyl cabinets (Figure 11)".
- But Fig 10 is Vinyl. Fig 11 is Melamine. This mistake shows that the article was never professionally reviewed. **Not Peer Reviewed.**

These Two Graphs Similar? NOT

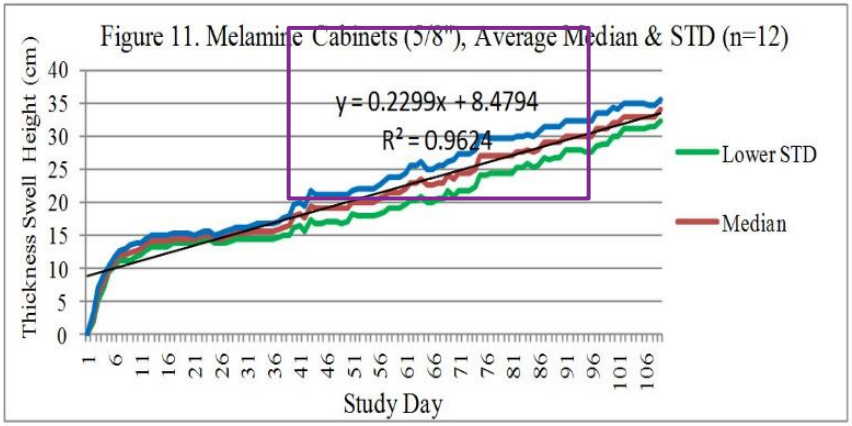


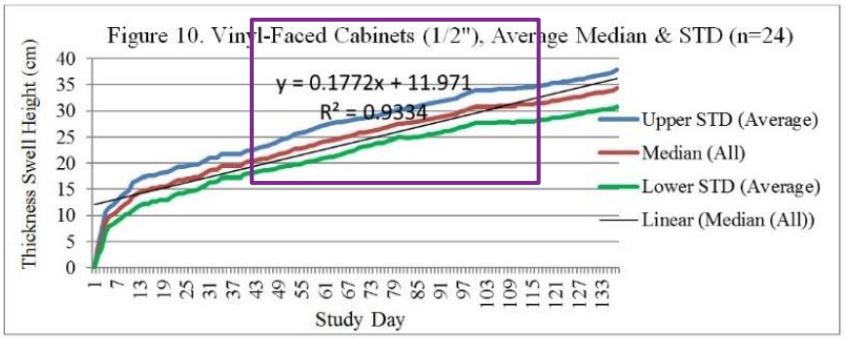


Per Moon: "A comparison between the vinyl (1/2") and melamine (5/8") TS rates shows that they are similar".

- Moon says: "similar". But the Melamine cabinet TS is flat between Day 11 and Day 41! Vinyl TS is not flat.
- No competent reviewer would allow someone to say the TS rates in these graphs are similar. **Not Peer Reviewed.**

Moon Says Vinyl vs Melamine Equations Similar

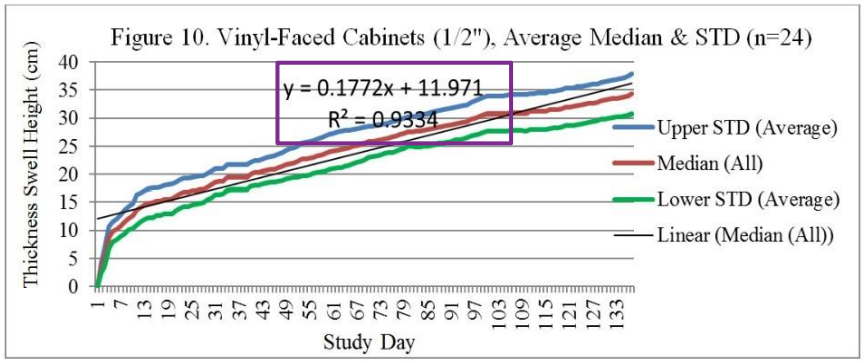


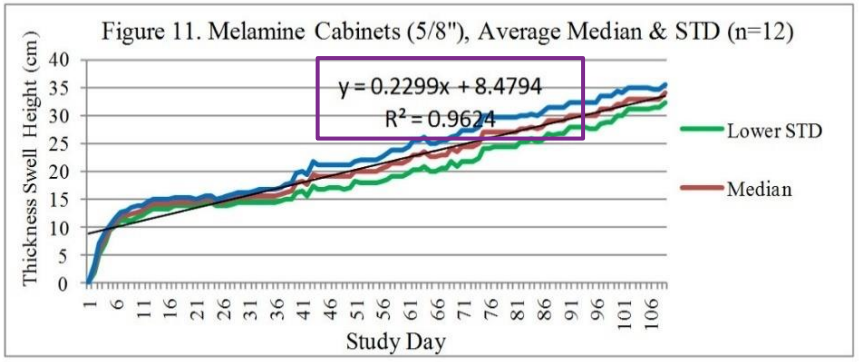


The melamine cabinets expressed the same accelerated TS rate during the first 12 days and linear rate thereafter as did the vinyl cabinets (**Figure 11**). A comparison between the vinyl (1/2") and melamine (5/8") TS rates shows that they are similar.

- Melamine equation is:
  Y=0.2299x + 8.4794
- Vinyl equation is:
- Y=0.1772x + 11.971
- Vastly different equations.
- No competent reviewer would say these are similar equations.
- Not Peer Reviewed.

Swelling Rate. NOT Similar

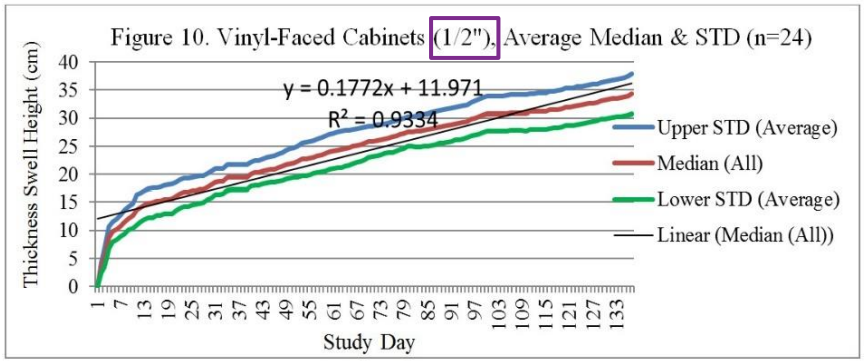


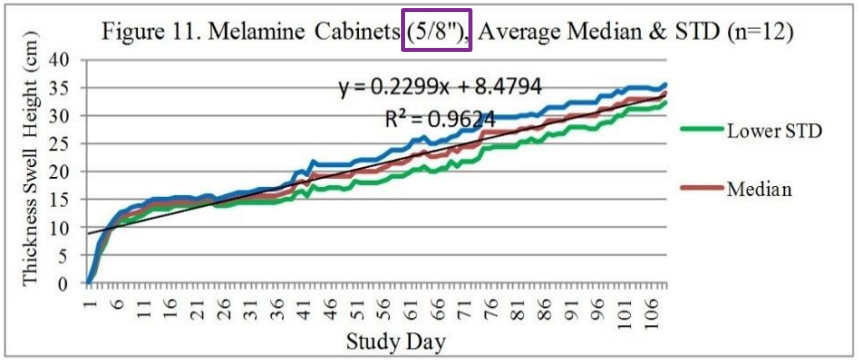


Per Moon: "A comparison between the vinyl (1/2") and melamine (5/8") TS rates shows that they are similar."

- 0.2299 and 0.1772 are the slopes of the equations and stand for increase in swelling per day (Swelling Rate).
- The Melamine slope is 30% faster but Moon concludes that they are similar.
- No competent reviewer would allow someone to say the equation slopes are similar. **Not Peer Reviewed.**

Apples & Oranges





Per Moon: "A comparison between the vinyl (1/2") and melamine (5/8") TS rates shows that they are similar."

- Moon here is comparing vinyl to melamine cabinets when they are different thickness (1/2 vs 5/8).
- A comparison is only valid when variables outside of what you want to compare are held constant.
- Any reviewer would catch this ridiculous comparison. Proves not only no peer review but authors have no idea about what they are doing.

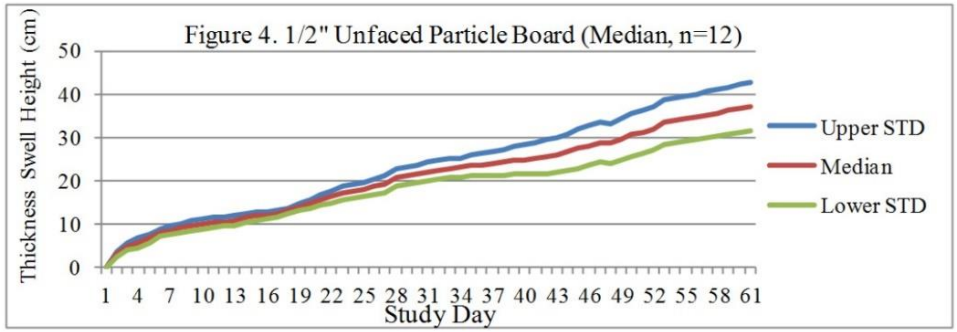
Panel Coating (Coated vs Un-Coated) No Difference?

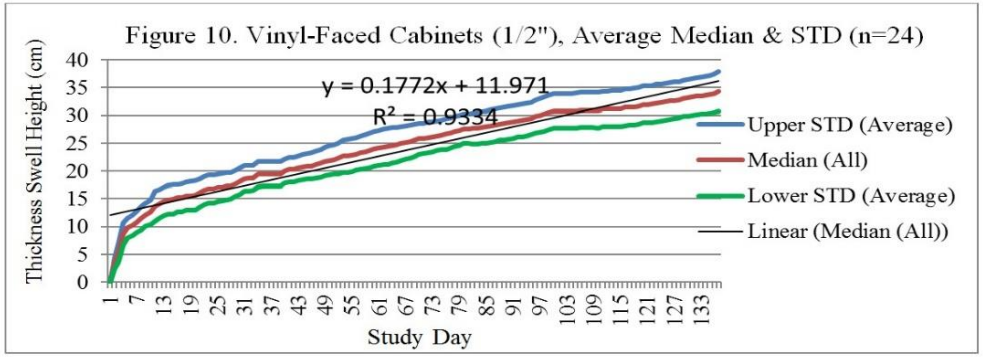
Per Moon: "Panel coatings (polyethylene, vinyl, melamine or none) had no appreciable influence on TS under the humid condition (>90% RH) examined. Under lower humidity conditions (50-65%), it is anticipated that the TS rate would be slower with more favorable evaporation conditions. We purposefully selected high humidity conditions because it was the easiest conditions to sustain inside the test chamber and it offered the most favorable conditions for moisture absorption."

Here Moon says no appreciable difference no matter if coated or not coated.

But check out the next slide.

Fig 4 ½" Unfaced vs Fig 10 ½" " Vinyl Unfaced

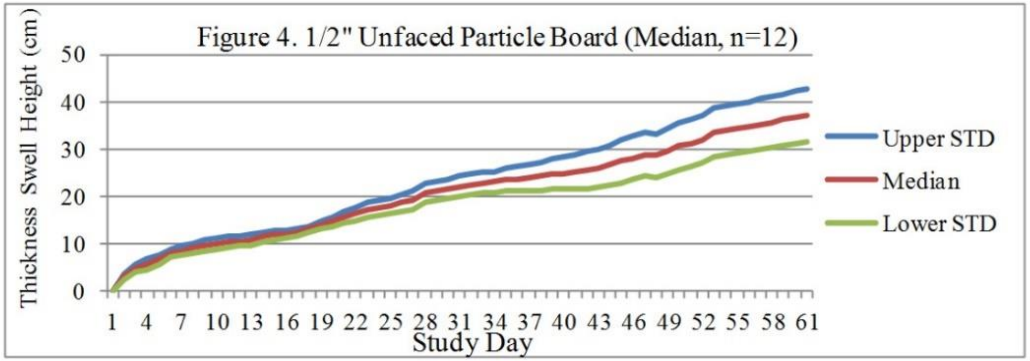


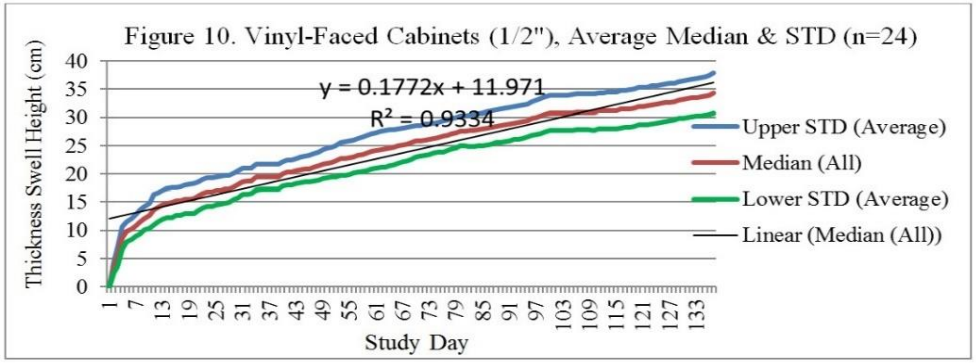


Top graph is unfaced (un-coated) particle board. Bottom is particle board coated with vinyl. Moon says these are the same. But look at the first 13 days.

- Saying that these two graphs (both ½") are the same makes no sense.
- And shows that this article was not subjected to serious professional review.

Fig 4 ½" Unfaced vs Fig 10 ½" " Vinyl Unfaced



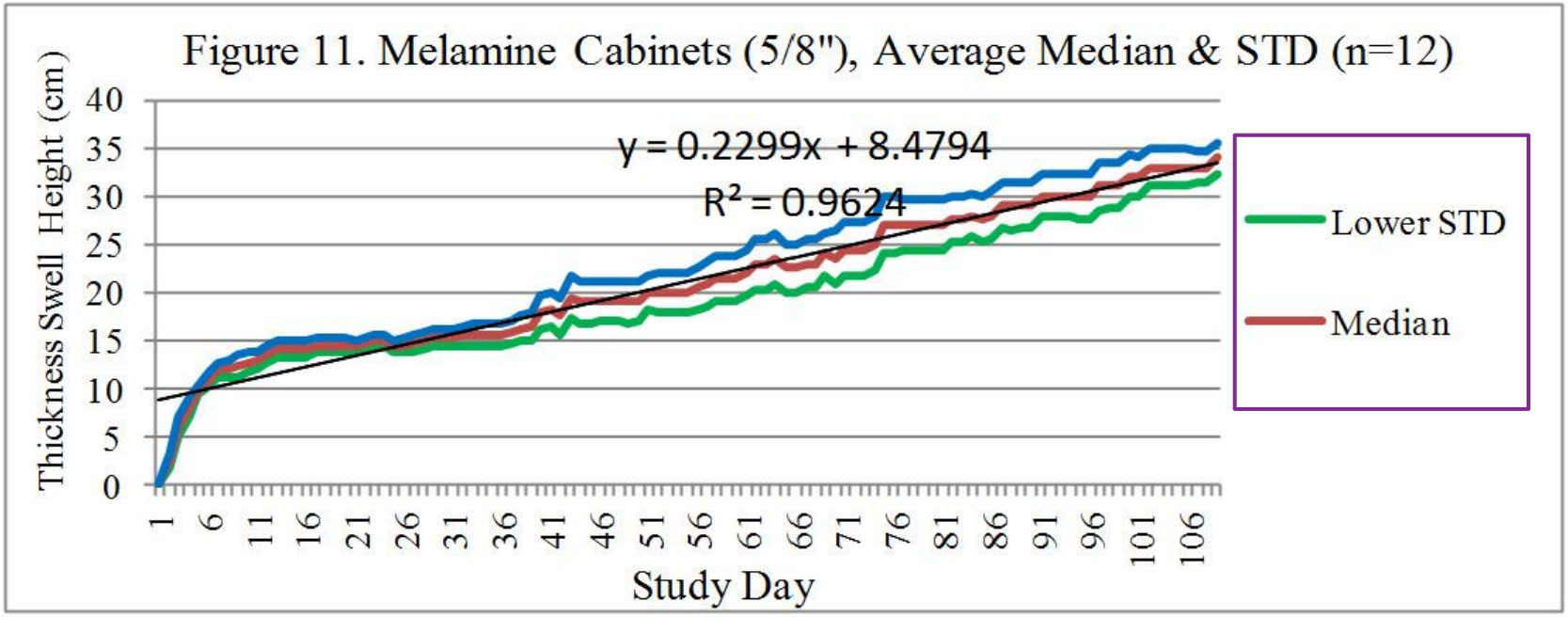


- Saying that these two graphs (both ½") are the same makes no sense. Not even close.
- Take for example Day 61. Fig 4 says height is 37 cm at Day 61. Fig 10 says height is 24 at Day 61.

Yet, Moon concludes no difference. Not Peer Reviewed.

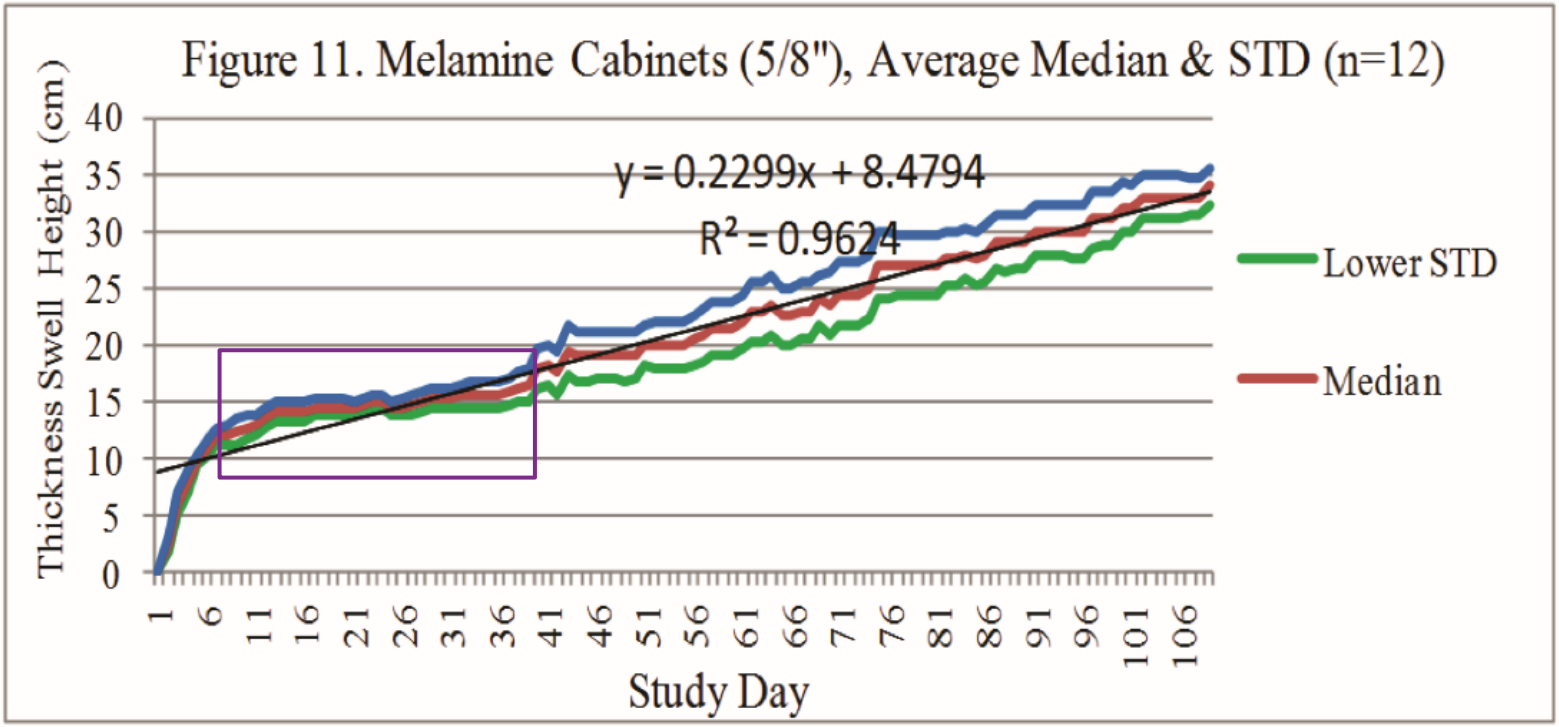
More On Figure 11 5/8 Melamine (Typical Cabinets).

More Mistakes



- Figure 11. See red rectangle. Moon forgot to label blue line.
- No competent reviewer has carefully reviewed the Moon graphs or they would have found this incorrect labeling. Not Peer Reviewed.

Closer Look at Equation in Fig 11



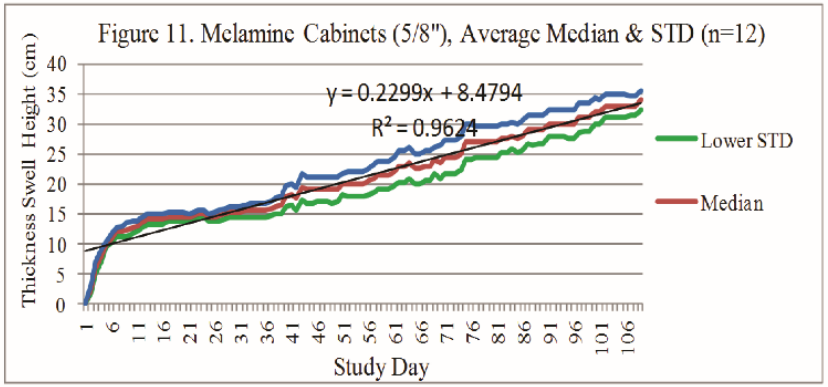
- Moon's plotted data is flat between 13 days from 39 days. 39 days of TS cannot be distinguished from 13 days.
- Moon's equation is of a line with a constant slope of 0.2299 and is of no use for this period of time.

Put Numbers Into Excel and Let It Spit Out the Results

- 5/8" Melamine. Typical cabinet material.
- Moon gets his exposure durations for claim denials from the equation in Fig. 11.
- When at his deposition he was asked how he calculated the equation Y=0.2299x + 8.4794, Moon said he just put the numbers into Excel and out popped the chart and the equation, and out popped the line fit with an R2 correlation of 96% (near perfect fit.)
- Moon left it to Excel to do the calculation and line fit equation.
    - Excel by default "selected" a straight line for the equation representing the data even though the data is clearly non-linear.
    - There is a rapid first phase curve starting at zero.
    - Next a flat period.
    - Followed by a straight line with a slope of 0.2299 and Y intercept of 8.4 cm.

Non-Sensical Equation Gives Non-Sense Answers

- Remembering your middle school algebra:
  - Y is the left vertical axis and is TS height in cm.
  - X is the duration in days of exposure (horizontal axis.)
  - Let's choose an easy number: X=Zero (before leak)
  - Y=0.2299x(Zero) + 8.4794 = **8.4794 cm height of thickness swell before the leak!**



So what Moon's equation (with, per Moon, a near perfect fit) says is that before any waste arm leak there was 8.4794 cm of TS height. Of course that's absurd!

Non-Sensical Equation Gives Non-Sense Answers

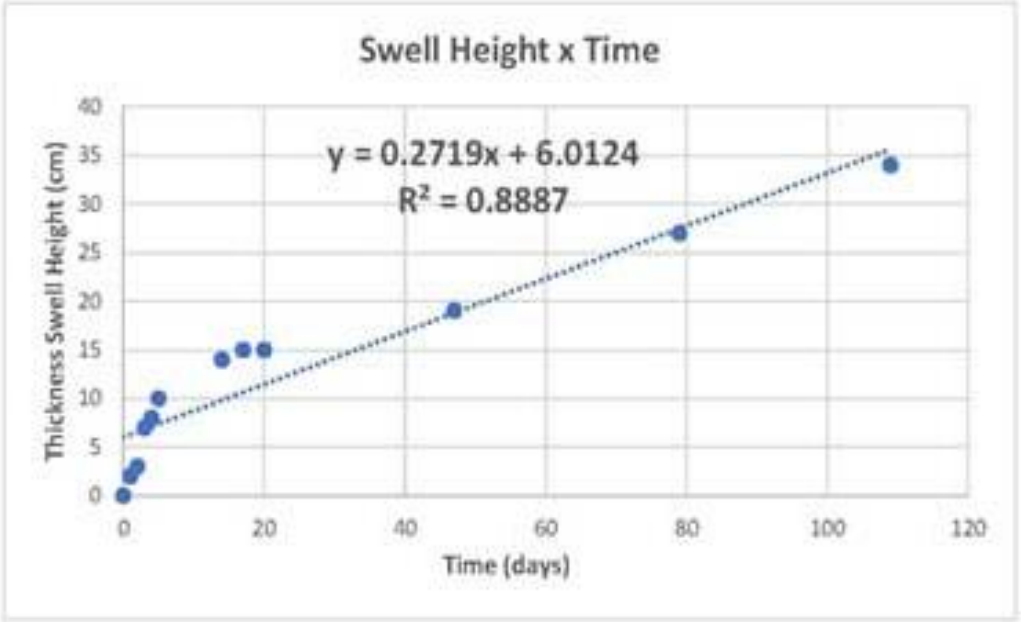
- Clearly Moon's equation (theory) for determining the duration of water exposure based on cabinet bottom TS height has nothing to do with the real world.
- If we plug in 2" (5.08 cm) TS height which is the approximate observable TS height of the cabinet side panel legs shown on the right, what do you get for duration?

Non-Sensical Equation Gives Non-Sense Answers

- Y (TS Height) =0.2299x X (Duration) + 8.4794
- Solve for Duration …
- (Height – 8.4794)/0.2299 = Duration in Days.
- When TS height is 2” (5.05 cm) you **get a negative number for the days of exposure. Non-sense!**

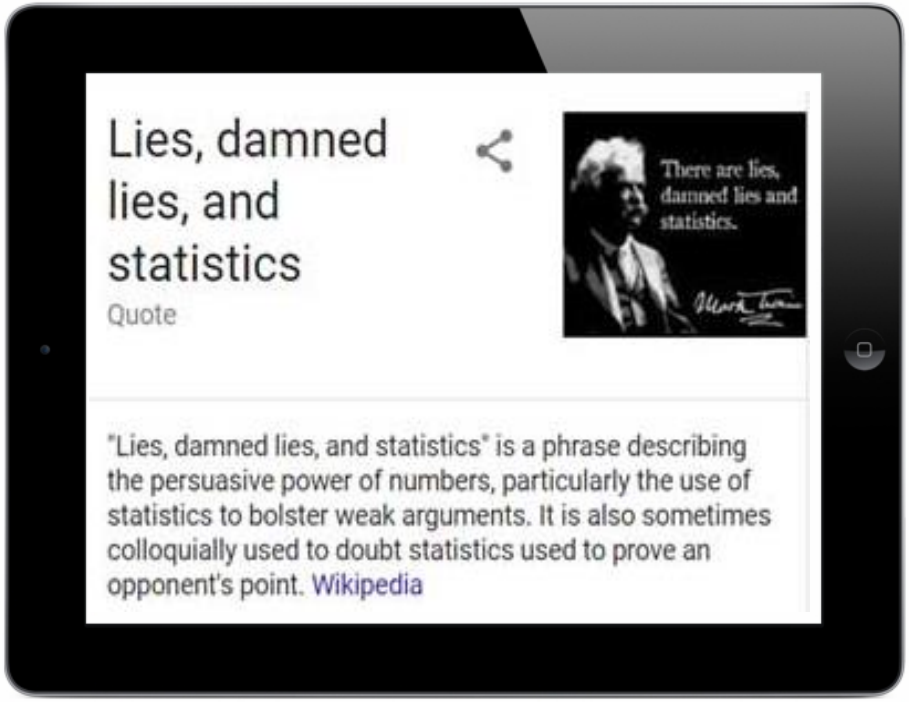
Recalculating Fig 11 Equation

Day	Swell Height (cm)
0	0
1	2
2	3
3	7
4	8
5	10
14	14
17	15
20	15
47	19
79	27
109	34



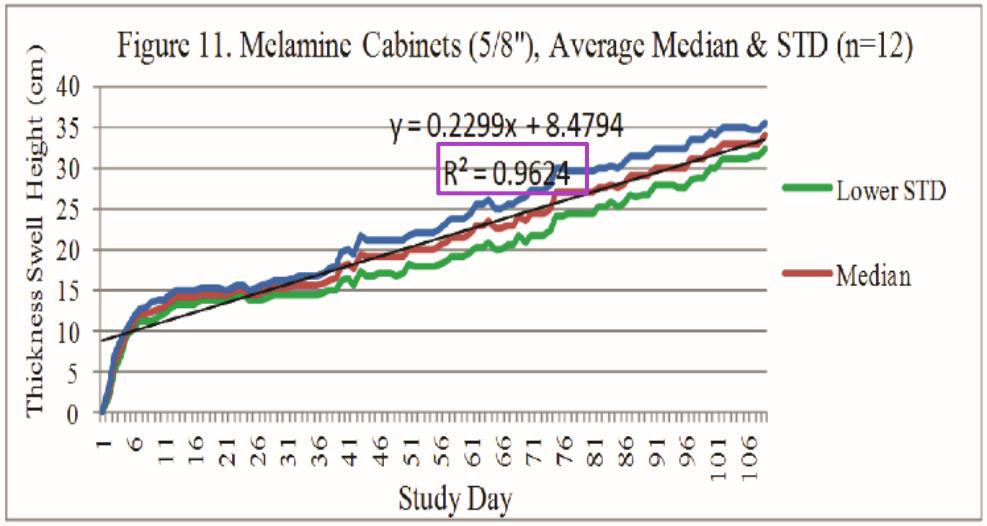
- We attempted to reproduce Moon's Fig 11 with data extracted from Moon's Fig 11 graph.
- With Moon's own data, we get R^2=0.8887 which is a poor fit and not R2=0.9624 that Moon (says he) got which is an awesome fit.

You've All Heard the Famous Mark Twain Quote on Statistics



- Moon draws a straight line through data that is clearly not linear.
- But by manipulating the data, Moon comes up with a super high correlation which makes no sense since his line does not look anything like the data.
- You would get the [misleadingly] high correlation by over-emphasizing data after day 41 where the data is linear.

More on Fig 11 Regression Analysis



Day	Swell Height (cm)
0	0
1	2
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47	19
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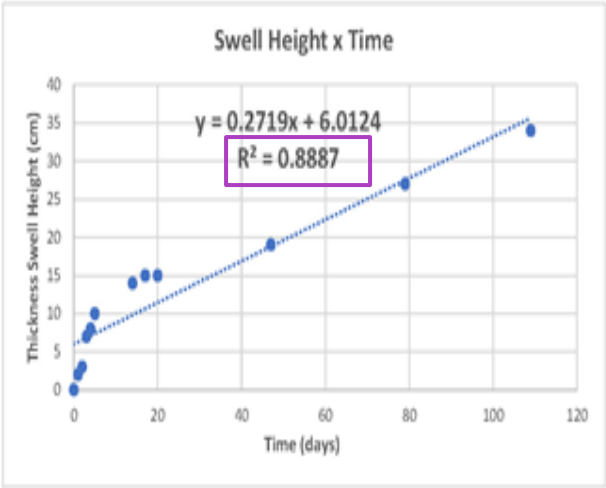
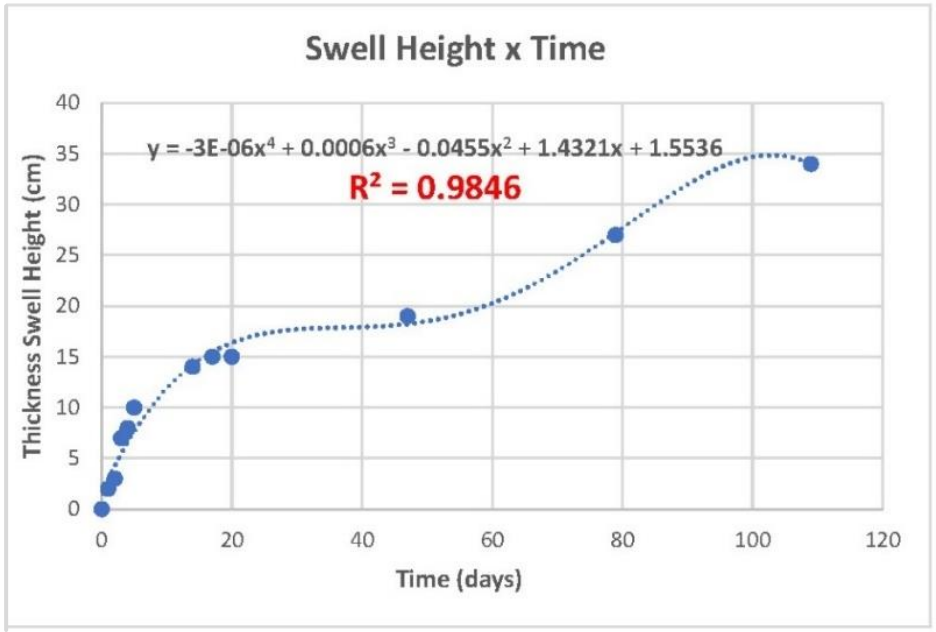
109	34



- Moon comes up with very a high R2 (.9624) by manipulating the data.
- Using 12 points from his graph we obtain a poor R2 (.8887).
- Who is right? Who is wrong? Same data.
- No way to know. Moon does not include data points. Only the graph.

More on Diagram 2 Regression Analysis

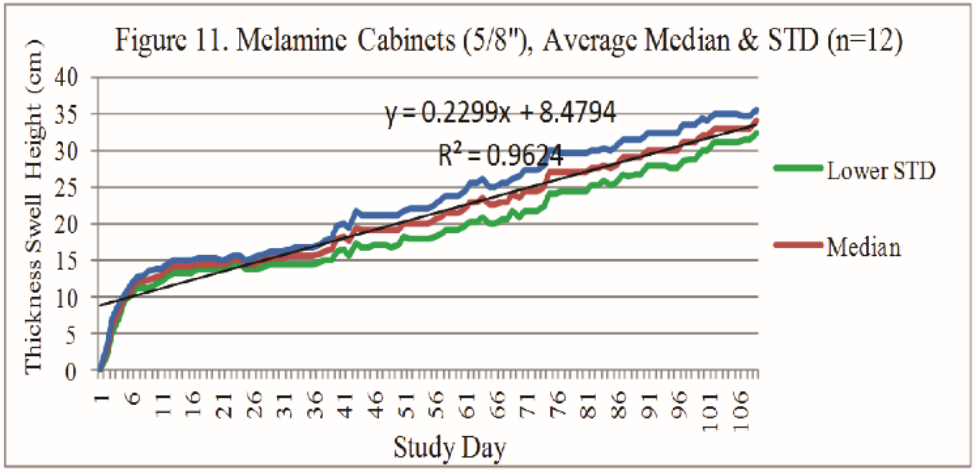
Day	Swell Height (cm)
0	0
1	2
2	3
3	7
4	8
5	10
14	14
17	15
20	15
47	19
79	27
109	34



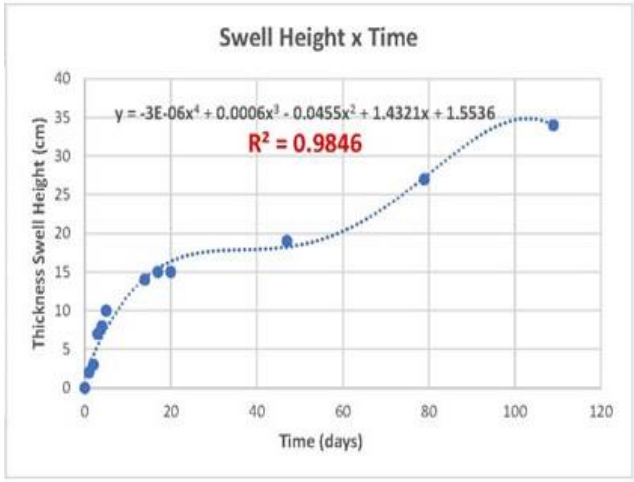
- Here we have redone the regression analysis using a non-linear function … same data.
- We get R^2=0.9846 which is an awesome fit both mathematically and visually the "line" fits the points.
- Clearly the data is not linear.

More on Diagram 2 Regression Analysis

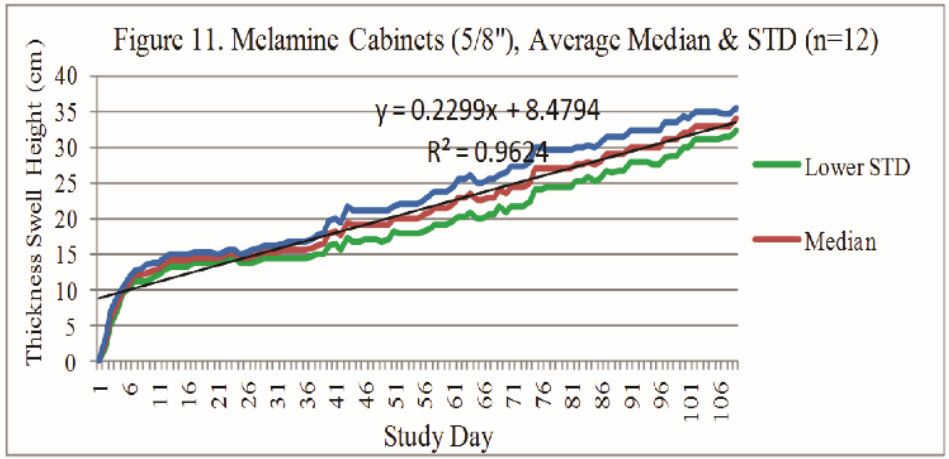
- Which has the better fit of the data?
- Our equation (bottom right) or Moon's, top right.
- They both have has similar R^2 values which means how well the data fit but clearly fit can be manipulated.
- Statistics can be deceptive.



Day	Swell Height (cm)
0	0
1	2
2	3
3	7
4	8
5	10
14	14
17	15
20	15
47	19
79	27
109	34



Showing the Data



Day	Swell Height (cm)
0	0
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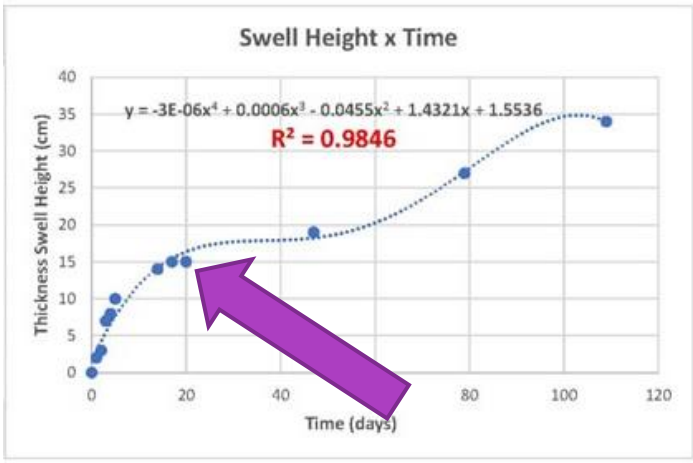


- None of Moon's graphs show the actual data points (Example Fig 11).
- Showing the data is so easy to do. Everyone except Moon does it because people want to see the data.
- On the right is our graph. Arrowspoint to data points.

Show Your Data

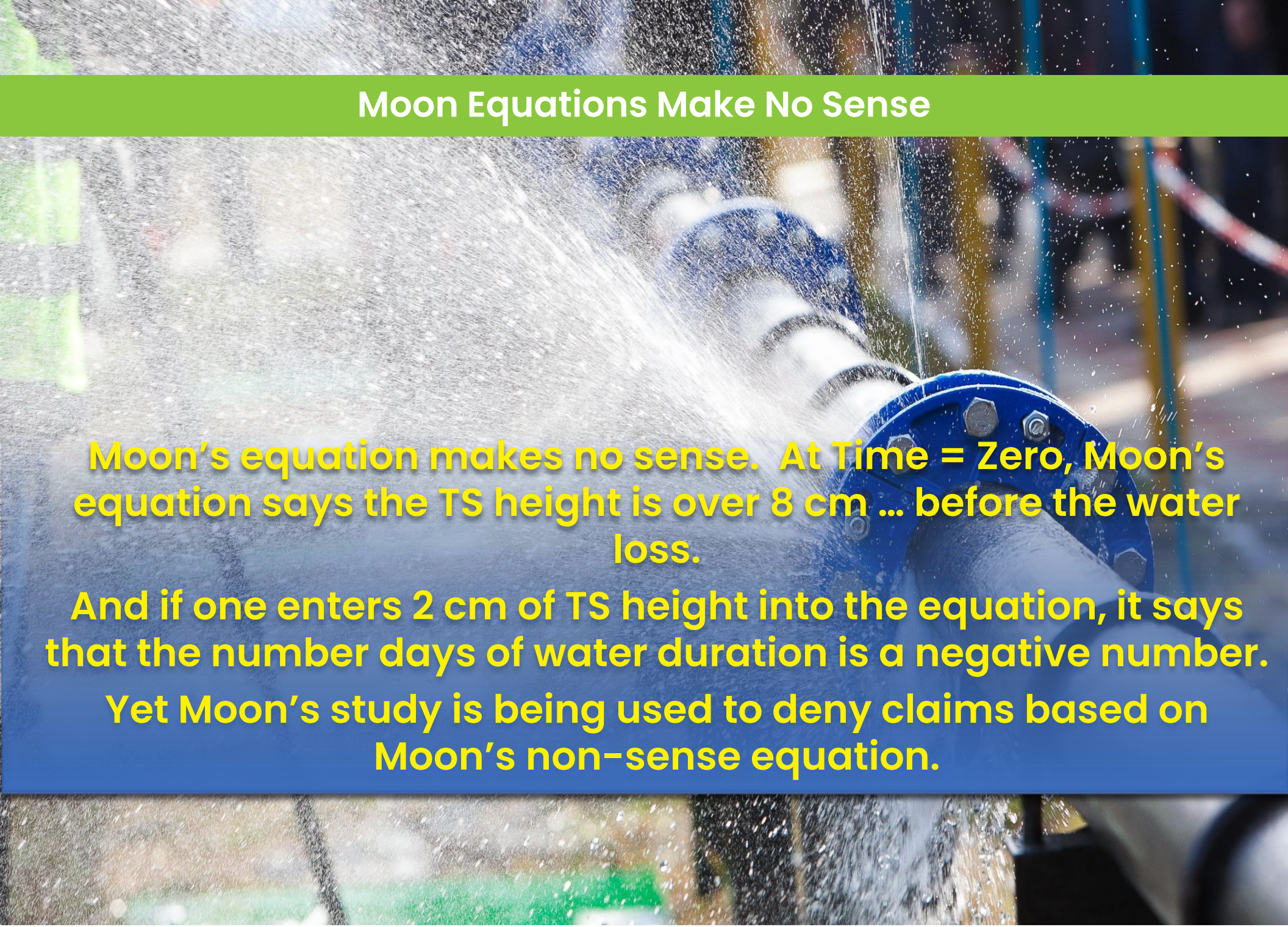
Careful reviewers want to see the actual data.

They want to see the data so they can do their own regression analysis (line fitting.)

Moon has been asked for the data that he used to develop these curves but has refused to supply it. Is it any wonder?

Not Peer Reviewed.

Moon Equations Make No Sense



Moon's equation makes no sense. At Time = Zero, Moon's equation says the TS height is over 8 cm … before the water loss.

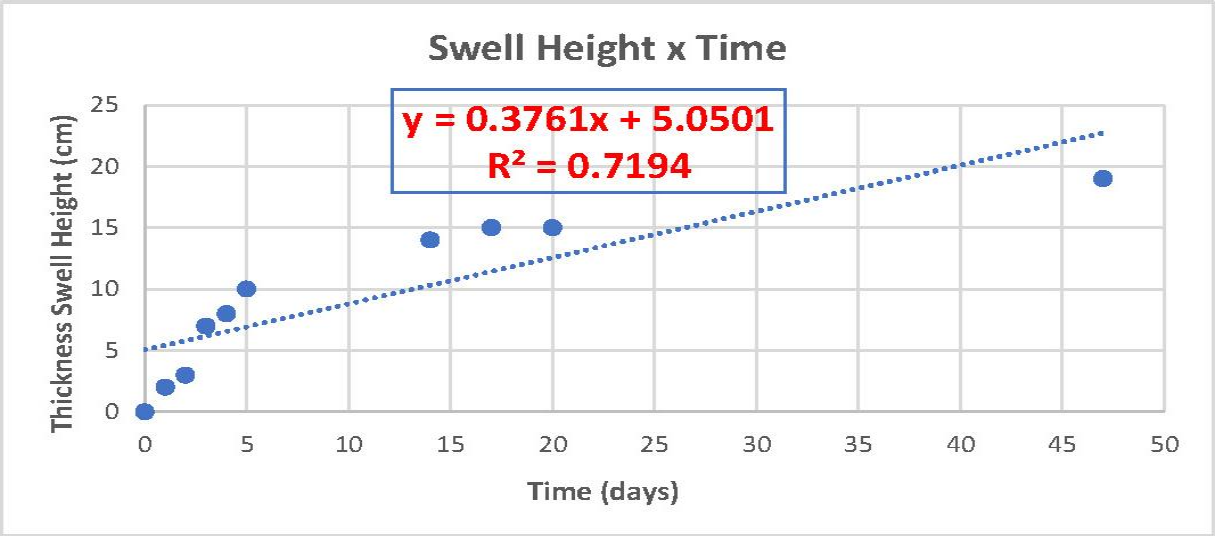
And if one enters 2 cm of TS height into the equation, it says that the number days of water duration is a negative number.

Yet Moon's study is being used to deny claims based on Moon's non-sense equation.

REDUCING THE DURATION OF MOON EXPERIMENTS

Recalculating Fig 11 Equation Shorter Time Frame

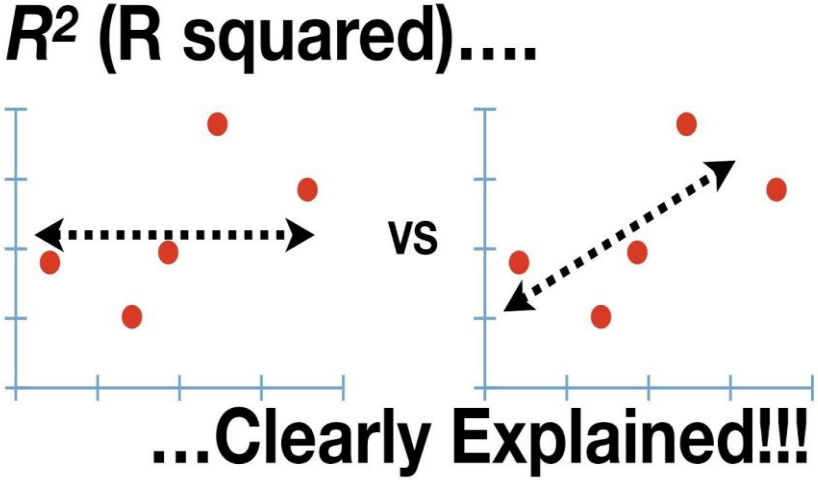
Day	Swell Height (cm)
0	0
1	2
2	3
3	7
4	8
5	10
14	14
17	15
20	15
47	19



- Here we eliminated data points that were beyond 47 days which were from the linear portion of the graph. And then recalculated the line.
- R2=0.7194 gets much worse when you look at time at day 47 and earlier.

Tricks to Improve R^2 Fit

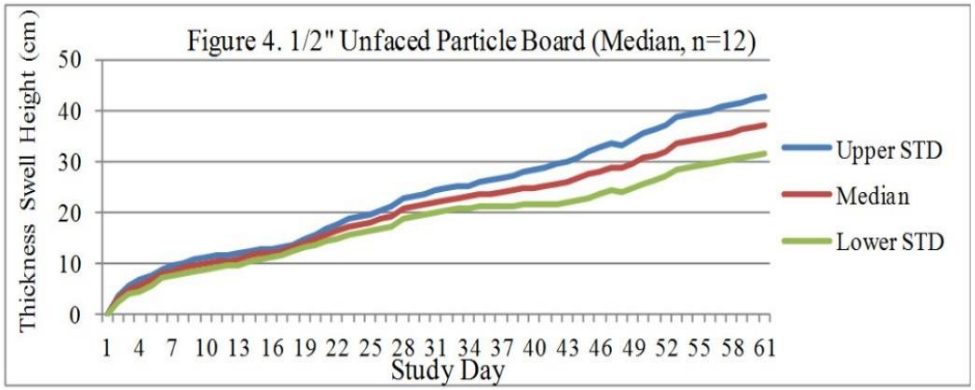
- All of Moon's experiments were run for 60 days or less, except the last two (Fig 10/11).
- What Moon does is run the last two experiments for longer longer periods of time (over 100 days) to add points to the linear portion of the curve (beyond approx. 41 days) to get a super high R^2.

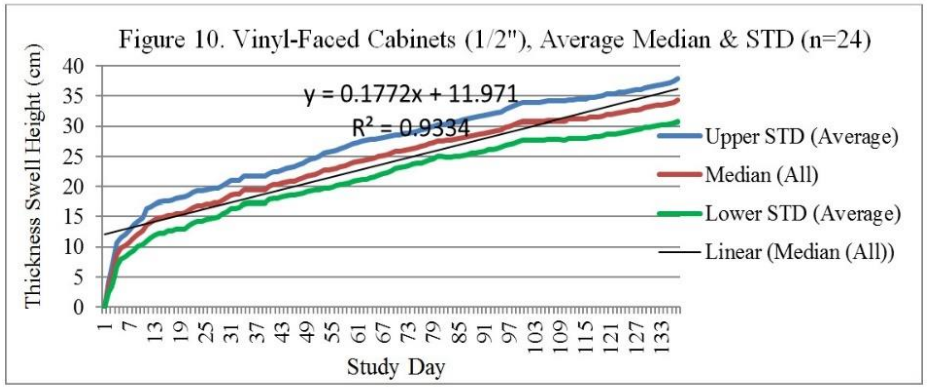


Click on the image above to go to a YouTube that explains R Squared

- But he then makes conclusions regarding the non-linear portion of the curve (earlier times).
- Not professionally Peer Reviewed because this practice is Junk Science. A Data Dump that swamps the reader with Junk.

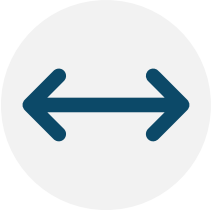
Longer Time Durations





- Moon's experiments that were run for 60 days or less did not have R^2 values calculated.
- Figure 10 was run for 135 days and here he calculated R^2.

Longer Time Durations



By doubling the length of time of the last two experiments (Figs 10/11), where the data out beyond 49 days is linear…

Moon gets a high R^2 even though the line he calculates does not in any way fit the earlier data.

This is how people manipulate statistics.

With the phony high R^2 (96%) Moon then claims that any number he comes up with for duration is accurate to 96% confidence. NOT Science.

96% Confident Long Term Water Event

- Moon always proclaims 95%-96% confidence in his denials by referring to this experiment.
  - Even though … his experiment was at 94% humidity and the insured home was <70% humidity. Apples vs Oranges.
  - Even though … TS rates are affected by density and he does not/ cannot measure the density of the particle board at the insured home. Apples vs Oranges.
- He always proclaims 95%-96% confidence in his denials by referring to this experiment.
  - Even though … the particle board in the home is 40 years old and Moon did his experiment with new particle board.
  - Even though … Moon shows the age of particle board has a huge impact on TS rate. Apples vs Oranges.
  - Even though … if the leak stopped at 14 days, there is no way to know how much expansion occurred as a result of the slow-drying saturated particle board, sandwiched between melamine faces, sitting on slow drying wet concrete slab and/or in a pool of trapped water.

96% Confident Long Term Water Event

- He always proclaims 95%-96% confidence in his denials by referring to this experiment.
  - Even though … IICRC requires that particle board cabinets contaminated with mold growth (Cat 3 water) be discarded without any regard to duration of exposure.
  - And according to Moon, mold is always present on particle board before day 14. See next section.

Because the Onset of Mold Is FAST

Mold starts to grow fast.

It is widely accepted that common, fast-growing molds (Aspergillus, Penicillium) will start to grow (germinate) within the first week under typical FLA conditions.

Mold Grows FAST

http:// clmmag.theclm,org/home/article/swept-under-the-rug

5-25-2010

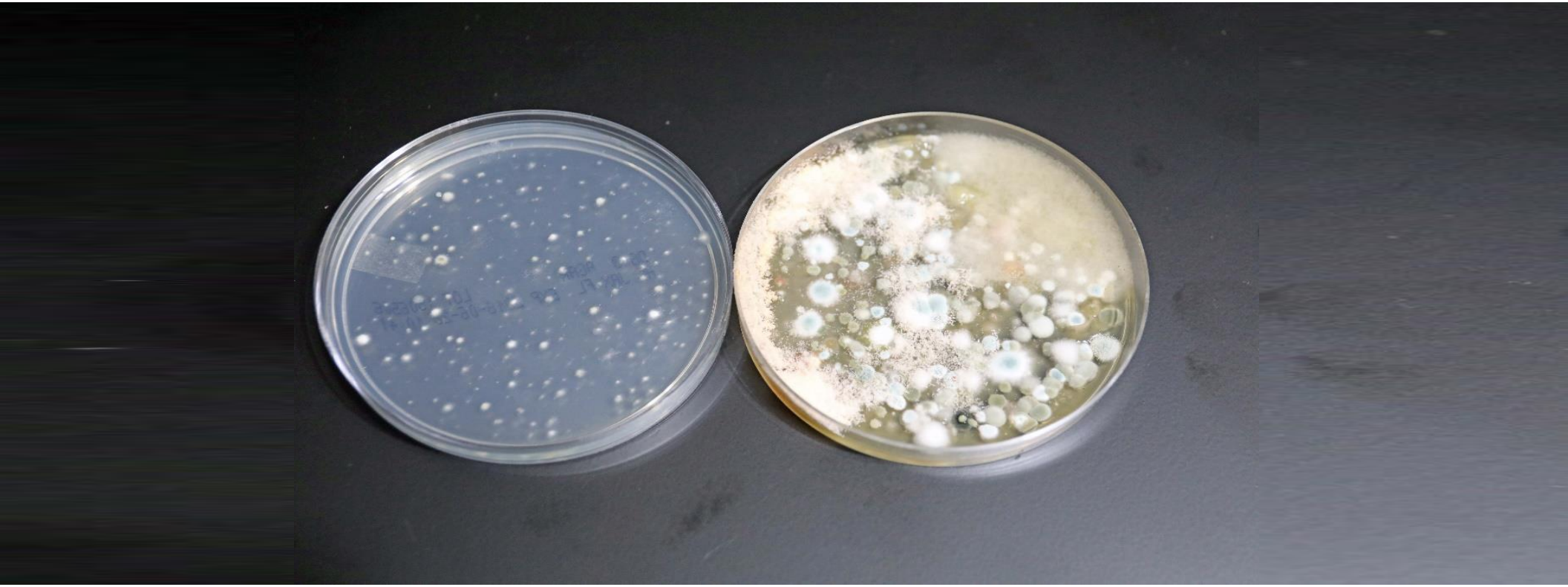
Swept Under the Rug

By Ralph E. Moon, Ph.D., CHMM, CIAQP

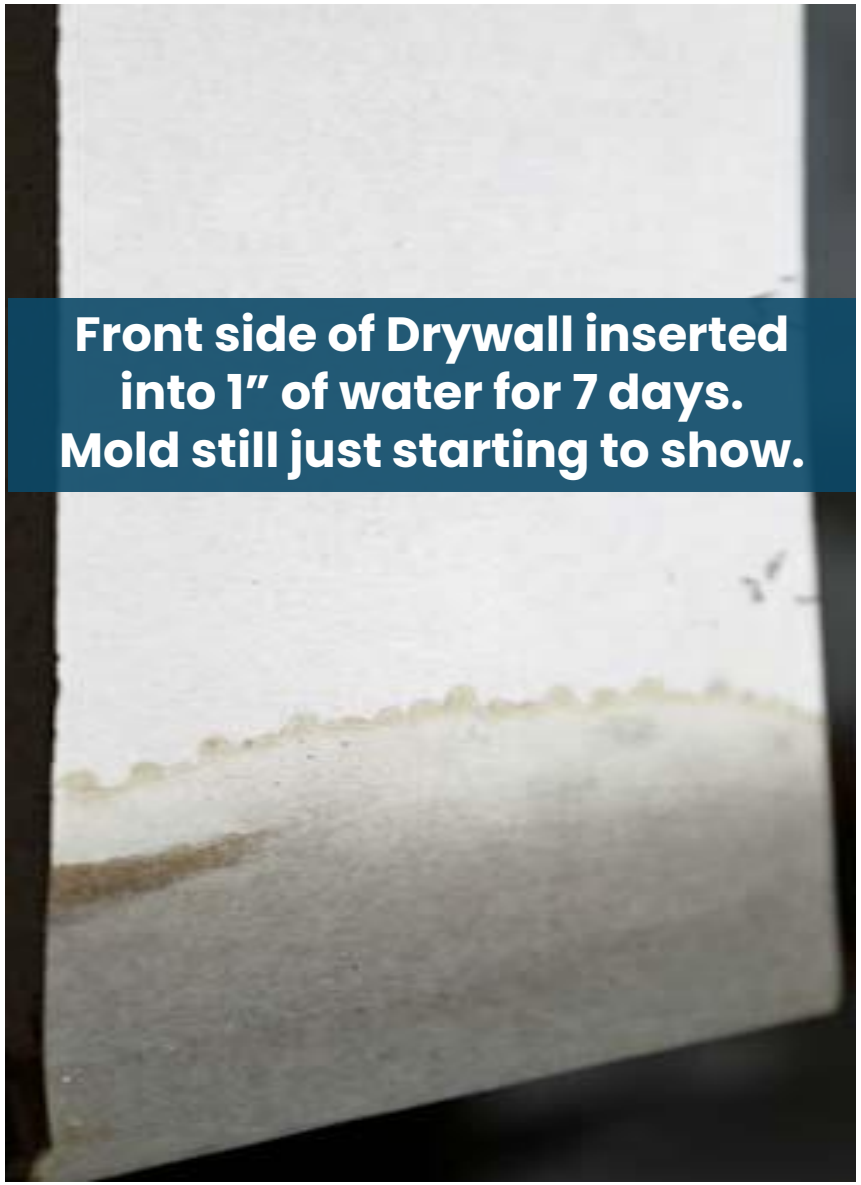
"Visible microbial growth can be observed within **two to three days** after continuous moisture contact." Ralph Moon, Ph.D.

Mold Grows FAST

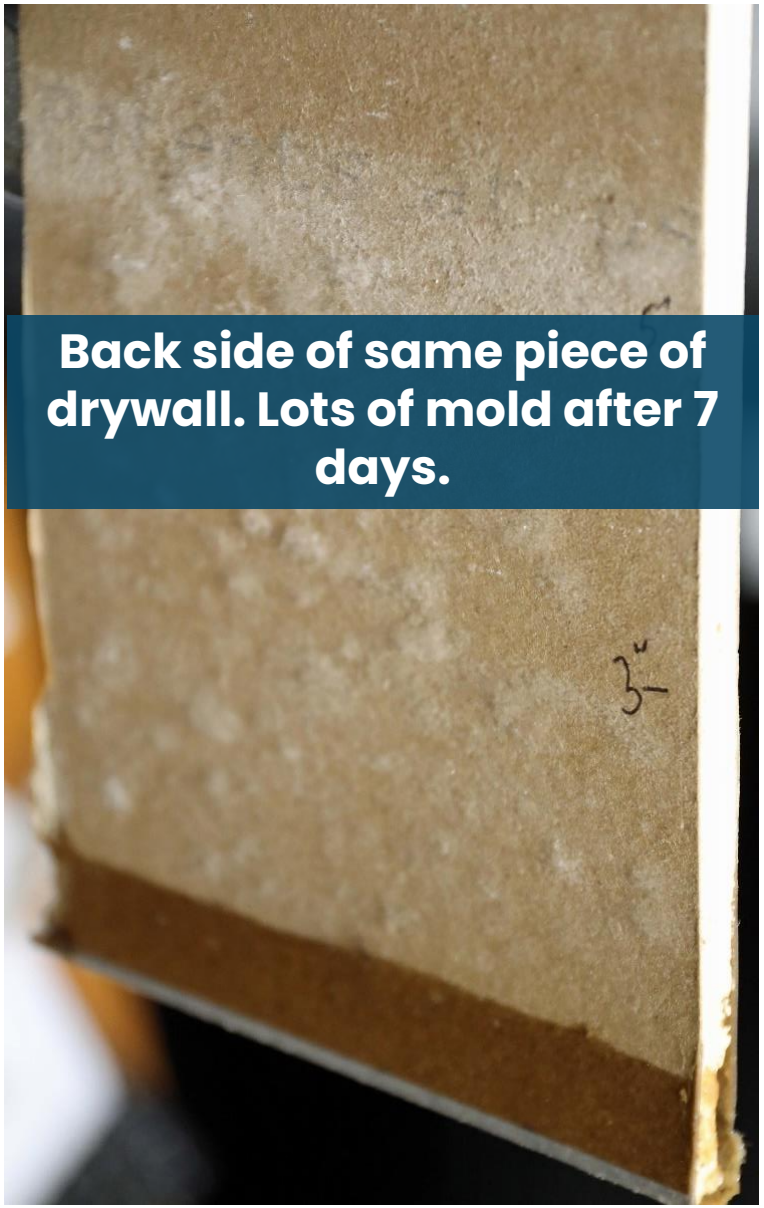
- On culture medium, air sample after 3 Days.
- Left is on DG-18 media/agar. Right is on Pro-Lab Potato Dextrose media/agar (overloaded after 3 days incubation). Lots of mold growth.



Our Drywall Study. Day 7. 80 Degrees. 65% RH.

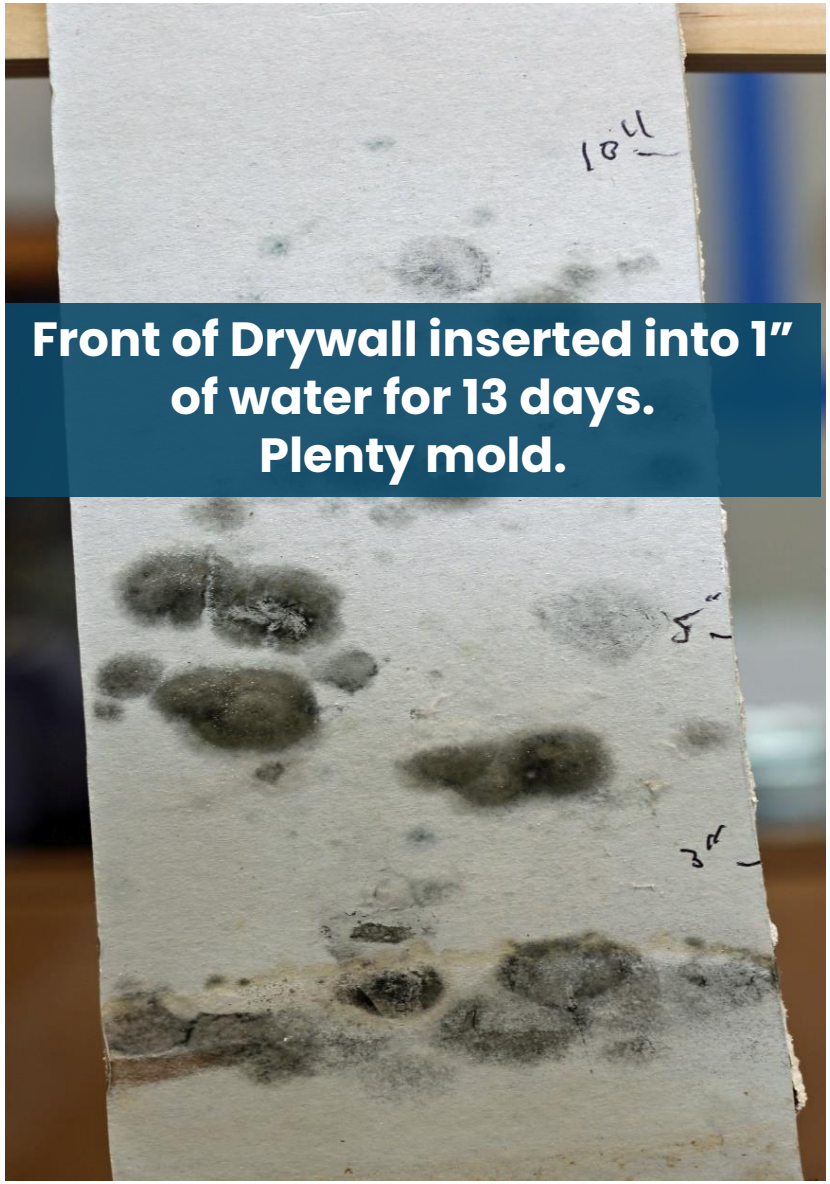


Front side of Drywall inserted into 1" of water for 7 days. Mold still just starting to show.



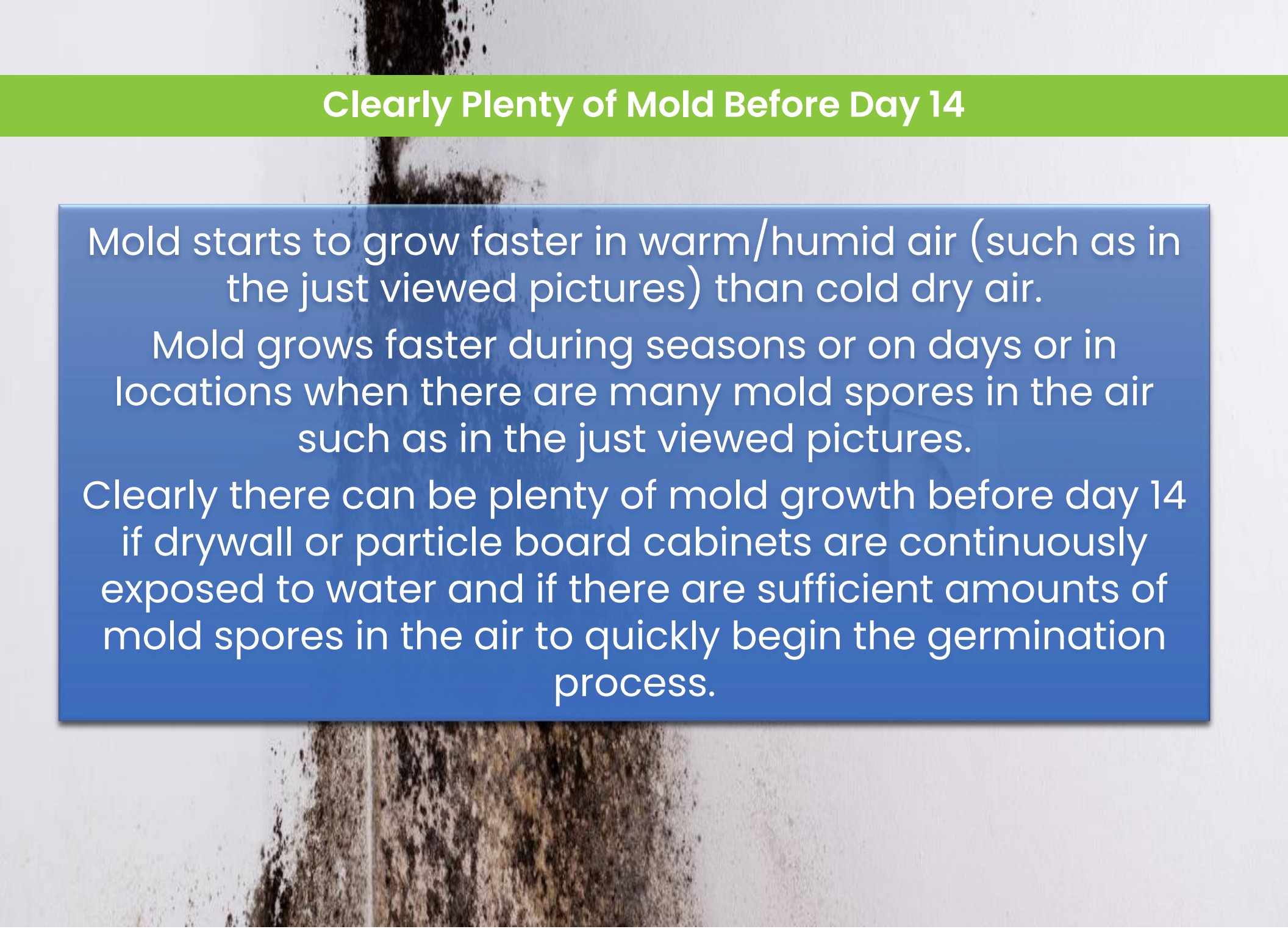
Back side of same piece of drywall. Lots of mold after 7 days.

Our Drywall Study. Day 13. 80 Degrees. 65% RH.



Front of Drywall inserted into 1" of water for 13 days. Plenty mold.

Back of same piece of drywall. Massive mold after 13 days.



Clearly Plenty of Mold Before Day 14

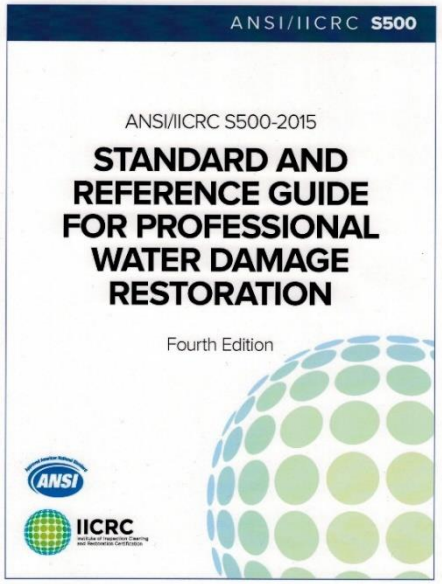
Mold starts to grow faster in warm/humid air (such as in the just viewed pictures) than cold dry air.

Mold grows faster during seasons or on days or in locations when there are many mold spores in the air such as in the just viewed pictures.

Clearly there can be plenty of mold growth before day 14 if drywall or particle board cabinets are continuously exposed to water and if there are sufficient amounts of mold spores in the air to quickly begin the germination process.

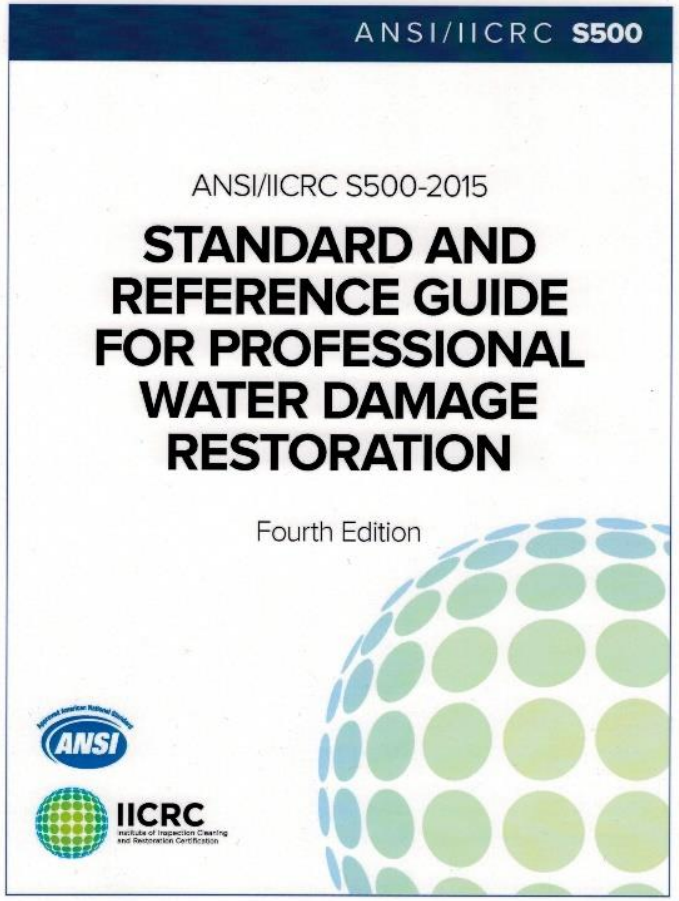
DO ANY OF THESE THICKNESS SWELL DURATION ISSUES REALLY MATTER?

NOT ACCORDING TO IICRC S500-2015



What is ANSI/IICRC S500-2015?

ANSI/IICRC S500-2015 is the American National Standards Institute approved Standard for Professional Water Damage Restoration.

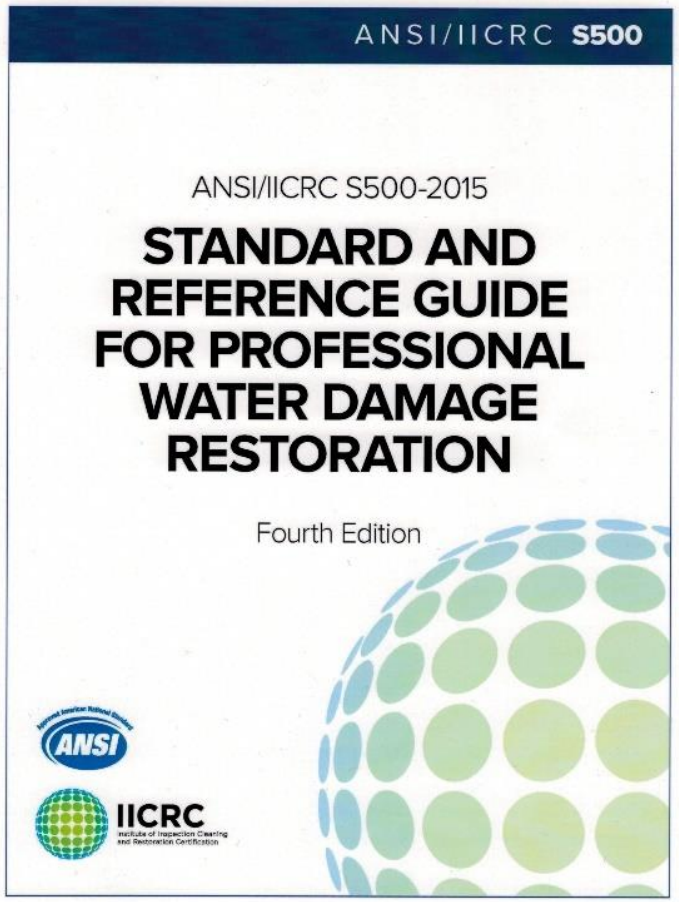


Per ANSI/IICRC S500-2015

Per IICRC, none of this discussion about TS duration really matters.

It makes no difference how long after 13 days the water leak lasted. Because:

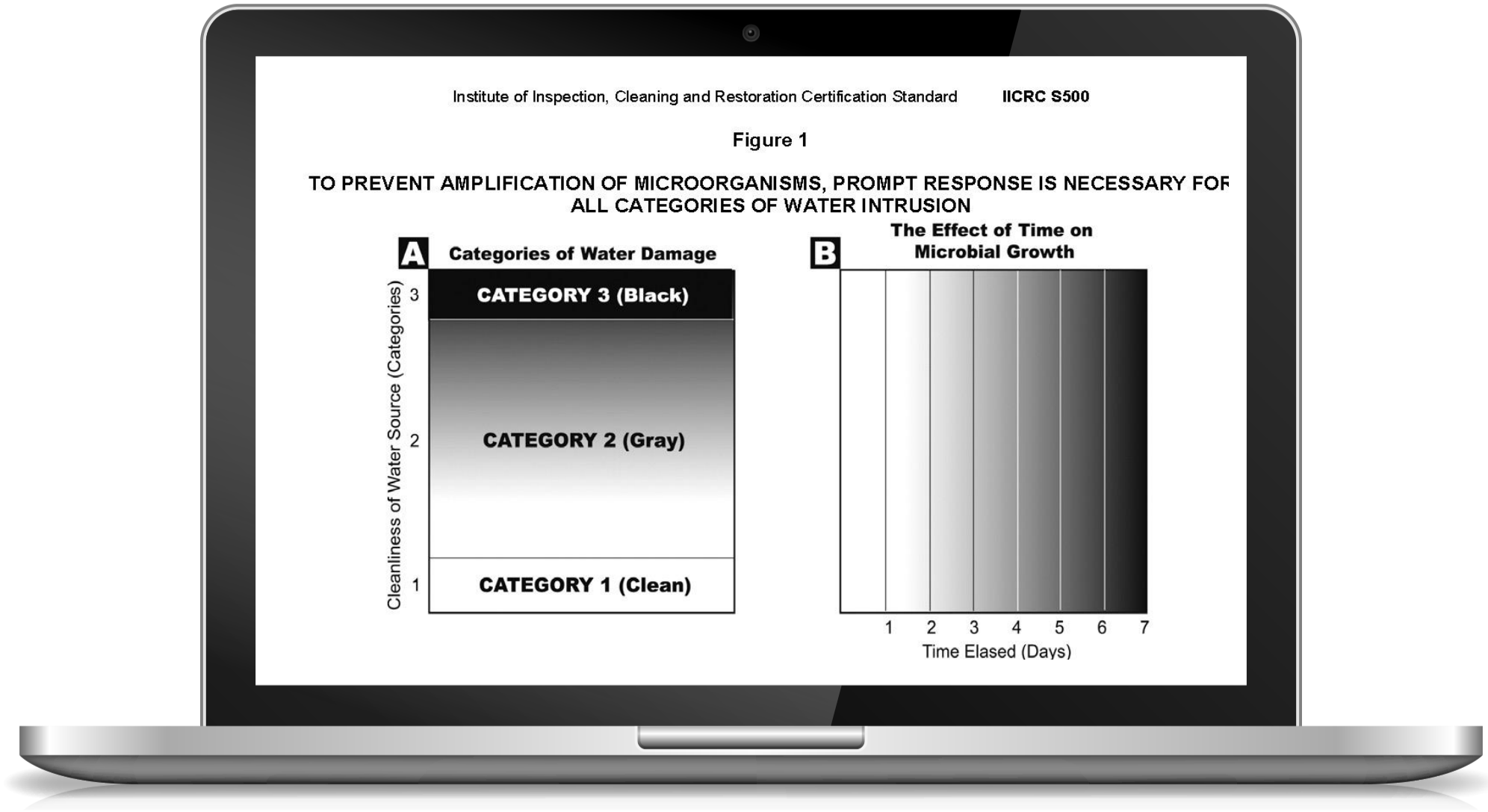
- Mold grows fast, so there will always be mold on wet cabinet side panel bottoms by day 14. As well as on surrounding drywall.
- Per ANSI-Approved IICRC Standard for Water Damage Restoration, microbial contaminated [Cat 3 contaminated] particle board cabinets are not restorable. Water exposure duration is not a factor.



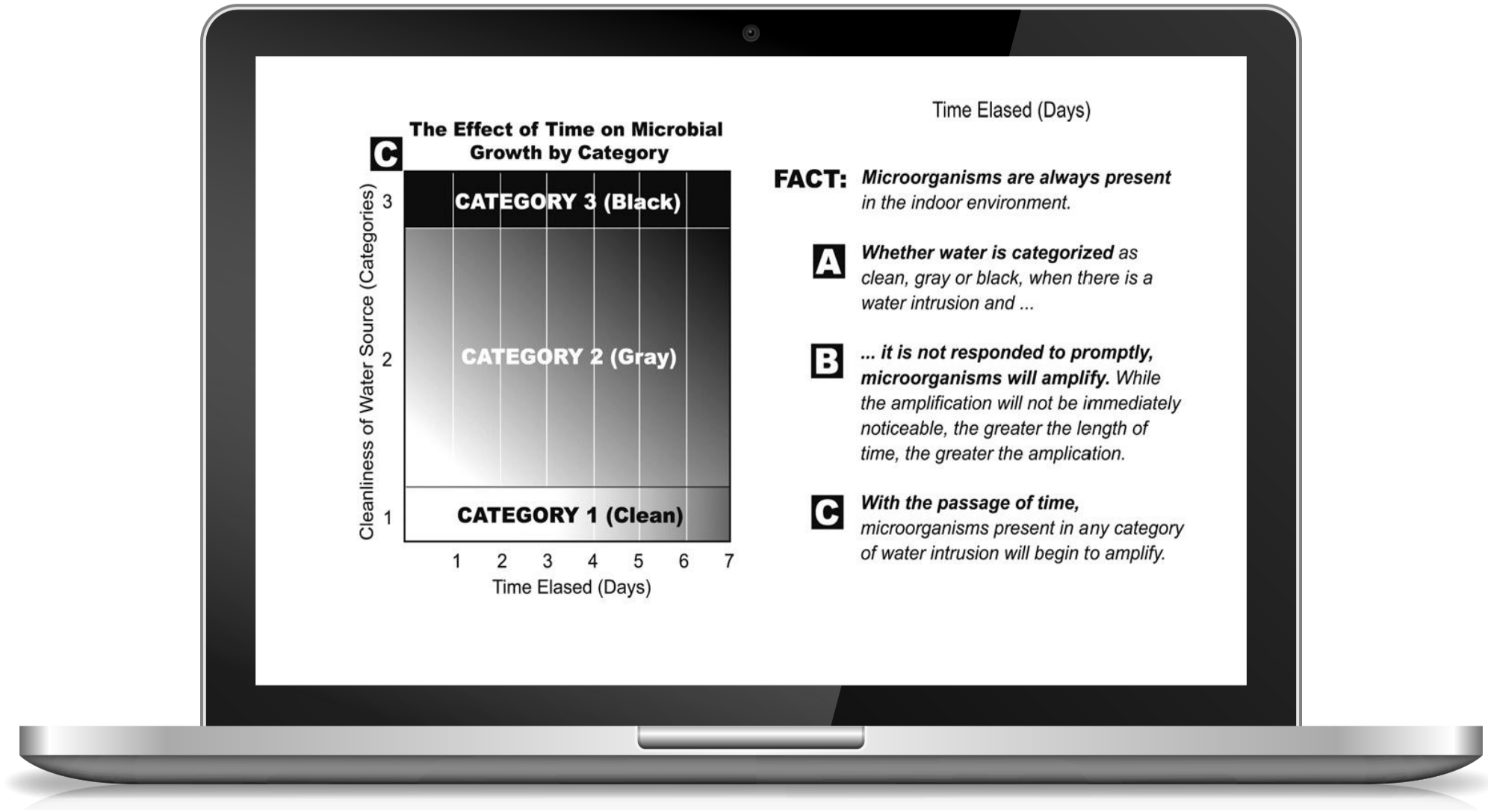
But Carriers Will Say "This Was a Clean Water Loss"

- Per IICRC, clean water (Category 1) turns to unclean, microbial contaminated water (Category 2 or 3).
  - Both odor producing bacteria and mold/fungi quickly start to grow on wet organic materials.
  - According to articles published in the IICRC journal, there will be heavy odor-producing bacterial growth within 8 hours of a water event.
  - According to the EPA, mold starts to grow within 48-72 hours.

IICRC: Effect of Time. Clean Water Changes Category



IICRC: Effect of Time. Clean Water Changes Category



Cat 1 Deteriorates to Cat 2/3.

IICRC S500: "Category 1 water can deteriorate to Category 2 or 3. Category 1 water that flows into an uncontaminated building does not constitute an immediate change in category. However, Category 1 water that flows into contaminated building can constitute an immediate change in category.

Once microorganism become wet from the water intrusion, depending upon length of time that they remain wet ant the temperature, they can begin to grow in numbers and can change the category of the water. Odors can indicate that category 1 water has deteriorated."

Cat 1 (clean water) turns to Cat 2/3 [microbial contaminated] water.

And the IICRC charts on the previous 2 slides show this can happen very quickly — immediately.

Particle Board Contaminated by Cat 2/3 Water

IICRC S500 17.3.2.1 Remove and replace in Category 2 or 3 intrusion.

Following a **Category 2 or 3 water intrusion, affected materials or assemblies that should be removed and replaced include, but are not limited to:**

- Carpet cushion (pad, underlay);
- HVAC internally lined duct board;
- Wall insulation (e.g., loose-fill, cellulose, mineral wool, fiberglass, open-cell foam);
- **Particleboard or MDF;** and many multi-layer flooring systems (e.g., laminate, vinyl sheet, parquet, engineered wood) under which Category 2&3 water has migrated cannot generally be sufficiently dried, cleaned, or sanitized.

Per ANSI-Approved IICRC S500-2015: Remove (do not dry) but replace with new, any particle board contaminated by Cat 2 or 3 water.

From Moon's Drip Drip Drip Article

https://www.theclm.org/Magazine/articles/drip-drip-drip/341

Drip, Drip, Drip 08/30/2011

A look at the inside of cabinet can reveal whether water damage resulted from a one-time event or a chronic leak.

By Ralph E. Moon, Ph.D., CHMM, CIAQP

"In the first experiment, all of the unfaced particleboard bases supported prolific microbial growth after Day 11."

- Dr. Moon shows in this article published in Claims Magazine back in 2011: Mold growth is quick on wet, particle board (such as cabinet side panel bottoms).
- Dr. Moon shows in this article published in Claims Magazine: Prolific mold growth after Day 11 (that is of course before Day 14) on wet particle board.

Per IICRC

Duration of Water Event Not Relevant

Therefore, TS height measurement for determining the duration of particle board of water exposure is Not Relevant.

Unless properly dried out ASAP after a water event, particle board cabinets will always need to be replaced with new due to Cat 2/3 contamination.

Per FLA 5th DCA: The duration of the water leak beyond day 13 is not relevant when irreversible permanent damage occurs before Day 14.

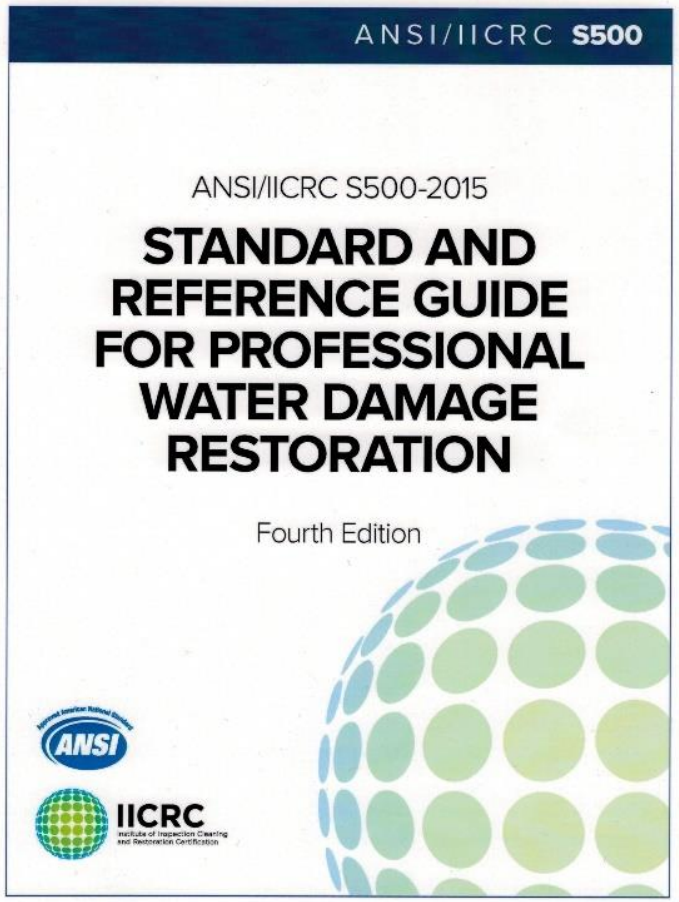
Mold growth on porous particle board is considered irreversible damage by IICRC S500-2015.

Carriers Deny Claims But Say They Comply with IICRC

Complying with ANSI-Approved IICRC S500-2015 requires discarding Cat 3 [microbial] contaminated particle board cabinets.

Yet Carriers will deny claims with complete disregard to the ANSI-approved requirements in the IICRC Industry Standard of Care.

While they publicly state that their policy is to comply with IICRC.



CONCLUSIONS

Let's Start This Section by Saying..

- There is no derivation of physics that demonstrates a linear regression as chosen by Moon to represent his data is appropriate.
- The linear relationship is a false assumption that mischaracterizes swell rate.

Misdirection

Since Moon shows that there is massive damage during the 1st 13 days which triggers insurance coverage

Since his linear equation is clearly not suitable for this short term period …

Studying what could be happening 60 to 110 days out is irrelevant ever if his linear regression were suitable and even if all factors were controlled.

This Moon study is misdirection. Take your eye away from the first 13 days.

Conclusion

Confounders NOT Accounted For

- Moon at the 2015 Forensic Engineering Conference proposed a theory for dating the duration of a water event based on measuring the Thickness Swell (TS) of water-exposed [particle board] sink cabinet side panels.
- Moon finds that in addition to duration of water exposure, other factors (confounders) can significantly impact cabinet TS from water exposure.
- Particle board density and water temperature are key factors (confounders) that determine the rate of TS in addition to the duration of water exposure.
- In a controlled test environment, one of course knows the temperature of the water exposure and can measure the density of the particle board cabinets.

Confounders NOT Accounted For by Moon.

Conclusion

Confounders NOT Accounted For

- However in the field one can never know the temperature of the water that impacted the cabinets.
- Neither can one ever know the cabinet density because measuring density requires cutting out a piece of the homeowner's cabinet and measuring off-site.
- Destroying the cabinets is not an option.
- Since the water temperature and cabinet density can never be determined/known (or knowable) the application of Moon's theory/ methodology is fatally flawed (i.e. not a reliable indicator).
- Therefore it cannot be reliably used to either reject a claim or serve as a defense for one.

Confounders NOT Accounted For by Moon.

Not Peer Reviewed

CERTAINLY HAS NOT BEEN PROFESSIONALLY PEER REVIEWED

Furthermore Per 5th DCA Ruling

Unintended Consequences

Moon 2015 rather than being of value in helping Carrier's deny coverage due to long term loss …

Does an excellent job proving that massive water damage occurs to particle board during the first 13 days triggering coverage.

Per FLA 5th DCA ruling, if there is damage before Day 14, the fact that there may be additional damage after Day 13 does not in any way result in coverage denial.

Furthermore Per 5th DCA Ruling

The fact that the water event is long term and not short term, does not in any way impact coverage if there was damage before Day 14.

Per FLA 5th DCA ruling, if there is damage before Day 14 …

And there is always both irreversible swelling damage to particle board cabinets before Day 14. Triggers coverage.

As well there is always microbial contamination to both particle board and surrounding drywall by Day 14. Triggers coverage.

Per ANSI-Approved IICRC S500-2015

Discard Microbial Contaminated Particle Board

Per ANSI-Approved IICRC S500-2015
Discard Microbial Contaminated Particle Board.
How long it swelled is NOT a factor.

PEER REVIEW TEAM

Peer Reviewers For This Moon 2015 Critique

- Gary Rosen, Ph.D. FLA Licensed: Mold Assessor; Mold Remediator; & Building Contractor. Independent Insurance Adjuster; B.S. Chemistry UF; Ph.D. Biochemistry UCLA
- Jared Rosen: B.S. Chemistry UF; MS International Business UF; MS Material Science UF; NAERMC Certified Mold Hygienist. (Author son.)
- Joseph H. Dabrowski, PE President – Visionary, Inc. MBA, BS Mechanical Engineering. Registered Professional Engineer in Colorado, Florida and Ohio
- Daniel Hindman, Ph.D. Professor Virginia Tech, College of Natural Resources and Environment

PROFESSOR HINDMAN C.V. & REVIEW OF MOON THICKNESS SWELL PRESENTATION

Daniel P. Hindman, Ph.D., P.E., LEED Green Associate
Associate Professor, Department of Sustainable Biomaterials, Virginia Tech

Education:
B.S., Agricultural and Biological Engineering
M.S., Forest Resources
Ph.D., Wood Composites Engineering

Professional Registrations:
Professional Engineer, Commonwealth of Virginia
LEED Green Associate, United States Green Building Council

Professional Affiliations:
National Frame Builders Association
American Society of Civil Engineers
Timber Framers Guild
Forest Products Society

Experience:

Hindman has been an Associate Professor in the Department of Sustainable Biomaterials since 2010 and an Assistant Professor since 2003 at Virginia Tech. At Virginia Tech, Hindman's duties include teaching, research and engagement.

Teaching assignments include:

- Wood Mechanics – Class detailing the basic understanding of statics and strength of materials related to wood. An important portion of this class is the relationship of water and wood products.
- Green Building Systems – This class discusses the principles used in green construction including the application of LEED and Earthcraft Virginia standards.
- Design of Wood Structures – This class covers the design of wood structures using the *National Design Specification for Wood Construction* (NDS) and associated building code discussion.
- Timber Engineering – Graduate level class focused on exploration of special topics related to timber engineering. Previous topics have included reliability, wood-moisture relationships, viscoelastic behavior, fracture mechanics, design of post-frame structures, and design of cross-laminated timber structures.

Research topics have included the study of timber design and connections, construction safety, and green building. Funded research projects totaling over $3.3 million have been secured by Hindman while at Virginia Tech from both public and private funding sources. Topics of research have included:

- Studying the intra-ring mechanical properties of wood strands
- Measure the mechanical properties of wood composite I-joists exposed to walking loads from workers
- Testing of fall arrest systems attached to metal plate connected wood truss roof systems
- Manufacturing of southern pine cross-laminated timber

- Development of hardwood cross-laminated timber

Engagement activities have included education efforts to various professional societies including the National Frame Building Association, the National Wood Flooring Association, Floor Inspectors Guild, and other local groups.

Peer-Reviewed Articles (Total of 35 Published)

- As, N., D. P. Hindman, Ü. Büyüksari. 2018. The effect of bending parameters on mechanical properties of bent oak wood. European Journal of Wood and Wood Products. 76(2):633-641.
- Mohamadzadeh, M., D. P. Hindman. 2017. Comparison of Mode II Fracture Toughness Test Methods for Wood and Wood-Based Composites. Journal of Testing and Evaluation. Accepted for publication.
- Hindman, D. P., J. Bouldin. 2017. Bending and Shear Stiffness of Cross Laminated Timber Using a Variable Span Bending Test. Journal of Testing and Evaluation. Accepted for publication.
- Morris, J. C., D. P. Hindman, M. Mohamadzadeh, T.L. Smith-Jackson. 2017. Effect of Bracing and Anchor Choice on the Strength of Metal Plate Connected Wood Truss Assemblies Carrying Fall Arrest Loads. Journal of Architectural Engineering. Accepted for publication.
- Hindman, D. P., M. Mohamadzadeh. 2016. Splitting Strength of Mortise Members in Timber Frame Joints. Journal of Materials in Civil Engineering. http://ascelibrary.org/doi/abs/10.1061/(ASCE)MT.1943-5533.0001664
- Hindman, D. P., L. M. Koch, T. Smith-Jackson, J. C. Morris, L. D. Shields. 2016. Simulating Loads on a Roof Structure Caused by a Worker Falling from a Roof Edge. Journal of Architectural Engineering. http://ascelibrary.org/doi/abs/10.1061/(ASCE)AE.1943-5568.0000229?af=R
- Hindman, D. P., J. C. Bouldin. 2015. Mechanical Properties of Southern Pine Cross-Laminated Timber. Journal of Materials in Civil Engineering. http://ascelibrary.org/doi/abs/10.1061/(ASCE)MT.1943-5533.0001203

Presentations on Wood Flooring and Moisture Conditions

Since 2008, Hindman has presented research and education lectures on topics related to wood flooring and moisture, including the discussion of engineered flooring construction and layup, test methods for examination of wood flooring defects, and radiant flooring use. Presentations to various groups have included the National Wood Flooring Association (NWFA), the Floor Inspectors Educational Guild, the Appalachian Hardwood Manufacturers, Inc. and the Virginia Forest Products Association.

Consulting

Hindman has conducted various consulting work examining defects related to wood flooring manufacturing, installation and maintenance. Most consulting projects have included laboratory testing (moisture content, specific gravity, Janka hardness, soak-dry cycling, fastener withdrawal testing) but some projects have included site visits.

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June 25, 2018

Gary Rosen, Ph.D.

Dear Gary,

Thank you for asking me to provide a peer review for your critique of "Thickness Swell in Particle Board: A Forensic Tool for the Duration of Loss". In the attached pages, I have included the results of my peer review. Overall, I agree with the main arguments you have presented, mainly that (a) the use of laboratory data detailing specific thickness swell behavior of particleboard under controlled conditions cannot be generalized to any particleboard source where details of the manufacture, age, specific gravity of board, temperature of water and other variables are unknown, (b) the article critiqued does show that irreversible damage is done to particleboard products through the wetting procedures used in a relatively short (i.e. less than 14 days) time period, and (c) no validation of the theory created was every conducted by Moon or any other researcher.

General Comments on "Thickness Swell in Particleboard: A Forensic Tool for the Duration of Loss"

I found this article to generally be of poor quality in terms of the presentation (grammar, editing) and the technical content. As a reviewer of many technical articles and previously a journal editor, I would find this content unprintable in its current state. The abstract also tries to make a vague connection between water losses due to flooding and thickness swell of particleboard products. However, the relationship is never discussed and the statements are incredibly vague.

One of the main problems with the article is the misuse and misapplication of the term 'thickness swell'. As the name implies, thickness swell (TS) is the measurement in the change in thickness of the board product after exposure to a wet environment. TS can occur with an increase in moisture content, but does not have to be associated with fiber saturation point (FSP) of the material. ASTM D 1037 *Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials* states "The thickness swelling shall be reported as a percentage of the conditioned thickness." ASTM D 1037 uses a 6 inch by 6 inch or 12 inch by 12 inch sample of the board thickness for testing. Measurements of the board dimensions and weight are taken before testing begins. Samples are "submerged horizontally under 1 inch (25 mm) of potable water maintained at a temperature of 68 plus/minus 2 degrees Farenheit." After the test period, the samples are removed and the dimensions are measured and the sample is re-weighed. This methodology provides a value of the thickness swell of a panel product. ***This is an established procedure commonly used in the wood composites industry for reporting thickness swell.***

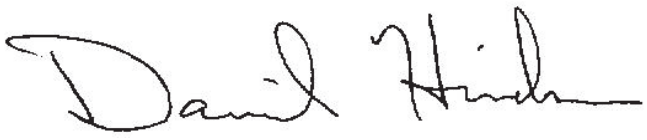
The method described by Moon uses a homemade contraption with a varying amount of water in the bottom (only refreshed every 3-4 days). No images of the testing apparatus are available, so the exact procedure cannot be shown. This test is highly non-standard and could be very selective in application. I understand that the idea of the work was to simulate the edge of the particleboard in standing water, but I question the temperature controls and methods used. This methodology is measuring 'thickness swell height' which has some properties in common with thickness swell, but will also be dependent upon the wicking and capillary action of water movement through the thickness of the panel.

The paper does attempt to use a variety of different commercial particleboard materials. However, no mention of where these materials came from or specific details upon their manufacture are present. In Thomas Maloney's *Modern Particleboard and Dry-Process Fiberboard Manufacturing*, which is considered one of the most valuable technical sources on the production of particleboard, Maloney talks about the different ingredients used to produce particleboard products. There are a variety of different adhesives, resins and different wood species used as substrates for the production of particleboard. The particular makeup of a panel is not common knowledge and may change depending upon the wood species sources or other market factors. One factor unconsidered in this particular discussion is wax, which is the most common additive, according to Maloney. Wax is mixed with the fibers before pressing to prevent absorption of water by the product which could lead to thickness swell. Comparing these commercial particleboard materials is rather difficult due to the unknown manufacturing parameters of particleboard production.

The curves presented for the thickness swell height do not follow a linear relationship. The curves could be described as curvilinear (polynomial), bilinear (two linear slopes) or trilinear (three linear slopes). The regression curve presented has an inherent problem in that the curve does not pass through the origin – to wit, any section of particleboard when exposed to water will immediately have a thickness swell height of around 12 centimeters. This is absurd to compare values for short term durations.

Much of the discussion section of this paper seemed to approach general speculation. Since no tables of values were given in the results, the discussion had few facts to focus on and could only make generalizations about the materials.

Sincerely,



Daniel Hindman