

I appreciate Chris and Ervin and the Forest Products Society's Willamette Valley Section for its effort in putting on this first CARB workshop. Thanks for inviting CPA. I probably would have come anyway since the CARB Composite Wood Air Toxic Control Measure is one of the four watershed regulations that have impacted the composite panel industry in my 25 year career here. However, when you threw in lunch and maybe a reception tonight, that sealed the deal. This is my second FPS speech ever and my second in as many months so I also have to applaud the organization for its recent relevance, at least as it regards the composite panel industry. You are probably asking what were the other three regulations. They were HUD in 1984, OSHA in 1988 and again in 1992, and MACT – both boiler and wood products - beginning for me in 1995 and regrettably, with no good end in sight. The common thread in all these regulations is formaldehyde, of course, and it is why we are here today. Formaldehyde, critical to every organic system on the planet, crucial to every major adhesive in the wood business and many others, and controversial to the core. I would like to say that I think we are about done with formaldehyde, and as I will discuss later, I believe this rule will be one the core of the reasons the formaldehyde issue will eventually fade. Who knows, though? The formaldehyde issue has been singularly uncanny in its ability to stay relevant.



Composite Panel Challenge: *Meeting the CARB ATCM*

John Bradfield, CPA
FPS Workshop; Eugene, Oregon; July 10, 2007



I will now present an overview of the main elements of the approved ATCM and endeavor to answer the questions that the FPS committee who sponsored this conference put to me a few weeks ago after I asked them which aspects of this issue they wished me to address.

Approved Phase 1 Standards

Product	Jan 1, 2009	Jul 1, 2009
HWPW-VC	0.08 ppm	-----
HWPW-CC	-----	0.08 ppm
PB	0.18 ppm	-----
MDF	0.21 ppm	-----
Thin MDF	0.21 ppm	-----



As Jim explained this morning, and many of you knew coming here today, the rule occurs in two phases. I don't want to spend any more time going over the numbers again so much as to point out several converging big picture trends that may not have occurred to everyone who has not examined these charts in detail, then thought about what they really mean. I believe one of the best aspects of the regulation is how, in stepwise fashion, the rule takes trends that were already established in emission reduction efforts in the industry and takes them to a logical conclusion. CPA believes CARB took the numbers lower than they needed to in phase 2, of course, but that difference in our separate analyses is probably to be expected. CARB staff stated its goal was to squeeze the blood from this turnip and that they will have done when Phase 2 is implemented.

Here in phase 1, the numbers are close enough to the Environmentally Preferable Product Standard set by CPA in July, 2006, that you can state that they are truly comparable, a little lower, .02 PPM for particleboard and a little higher, .01 PPM for MDF. Essentially CARB is telling us that what is now our preferable product, at 0.20 PPM, must become our standard product.

Approved Phase 2 Standards

Product	Jan 1, 2010	Jan 1, 2011	Jan 1, 2012	Jul 1, 2012
HWPW-VC	0.05 ppm		-----	-----
HWPW-CC		-----	-----	0.05 ppm
PB		0.09 ppm	-----	-----
MDF		0.11 ppm	-----	-----
Thin MDF		-----	0.13 ppm	-----



I'd like to say a word about hardwood plywood and variance in ceiling limits in product standards here. Basically, hardwood plywood is being asked to do, in phase 1, what particleboard and MDF are being asked to do in phase two and in phase two it is being asked to eliminate UF adhesives, at least as they are presently available, from their mix. I'll let Bill Altman expound on the rest of that subject.

On to variability. We assume that our products have about a 30% coefficient of variability, based on our long history of emissions tests. That means, in order to meet a 0.18 PPM limit your target needs to be about .12 PPM and a .09 PPM limit means a target of 0.05 PPM. Like I said, at the phase 2 limit, we will have squeezed all the blood out of the turnip, or in this case the formaldehyde out of a UF based system. In fact it is likely that most plants will not be able to use a pure UF system any more, but will use a highly modified UF base system. If you want to get more out you will have to get yourself another vegetable, or in this case, another adhesive system, which would only come at great and unnecessary expense, in the case of Particleboard and MDF products.

FPS Workshop Questions

- Formaldehyde Sources in Composites
- Opportunities for Reduction
- Opportunity Cost
- Measurement Issues
- Economic Impact of Rule
- California Market/Impact




As I mentioned, I was asked to address 6 questions relating to particleboard and MDF producer's and our issues regarding the CARB rule.

- Formaldehyde Sources in Composites
- Opportunities for Reduction of Formaldehyde
- The cost of those opportunities
- The measurement issues involved
- The economic impact of the Rule
- And the Market impact in the state of California

COMPOSITE PANEL ASSOCIATION

Where is formaldehyde in your process/products and why?

- Native Formaldehyde in Wood
 - WKI Study
- Formaldehyde Resin Systems Available to Composite Producers
 - UF
 - MUF
 - MF
 - PF
 - Combinations: PF-ISO; UF-ISO; MUF-PF, etc.



The first question CPA was asked to address is the source of formaldehyde in in our products. Formaldehyde, as many of you know, is a natural component in any biological system and is a native component in wood. WKI spoke earlier today and they did some research in the 1990's that quantified the levels of formaldehyde in wood. They are low, but are measurable. By the chamber tests we do the emission numbers are typically less than 10 PPB.

Most of the formaldehyde comes from the adhesive, of course, and the challenge has been to remove it from the Urea formaldehyde based adhesives. As for the why, formaldehyde is the key to reactivity in the adhesive and, all other things being equal, more formaldehyde allows you to achieve stronger bonds more quickly in the production process. Today and certainly through phase 1 of the rule we will be using low emission UF adhesives. However, the UF bonding system depends on some level of excess formaldehyde to achieve the bonding properties required by particleboard, MDF and hardwood plywood customers. By the time we reach the extremely low levels in the second phase of the rule, current UF adhesive technology runs out of steam and simply can not provide a sufficient bonding mechanism to meet our physical property requirements. Our choice is to switch to a more expensive system, like a phenolic based system or an isocyanate based system or to use an expensive fortifiers like melamine. The final regulation is expected to have what I refer to as an 'opt out' provision for products with essentially background emissions, For those products, a phenolic or an isocyanate option or a PF-ISO adhesive is a technology likely to be used. However, the current sense is that the adhesive system we will be using will be some version of a highly modified, melamine fortified system. One of the advantages of the isocyanate adhesive system is that it allows for a very quick bond to be developed, with no added formaldehyde. Consequently, if our customers can accept the cost, it is possible that some facilities might use a UF-ISO combination system to maintain production capacity. Quite frankly, a lot of this technology is still being worked out and we will have to see what kind of developments occur, both on the technological side and on the marketing side – what our ultimate customers are willing to pay for our product.

Can Formaldehyde be minimized or easily removed?

- It took 5+ years to finish this rule.
- Technical Challenges
 - Adhesive
 - Energy
 - Product Quality
- Industrial Challenges
 - Built infrastructure, supply chains
- Cost (Next)



We started work on this rule roughly one week after 9/11/2001. If it would have been easy to do this it simply would not have taken us 5 years to come up with a fair rule. Originally, CARB was predisposed to simply eliminate the use of urea formaldehyde adhesives in particleboard, MDF and hardwood plywood.

The problems with eliminating UF are several fold. First, the alternative adhesives available are phenolic, isocyanate, soy and polyvinyl acetate. They are all technically problematic in addition to being more costly. After a lot of work one hardwood plywood manufacturer has switched to a soy adhesive, but neither soy nor PVA adhesives can be used to produce particleboard or MDF at this time. Isocyanates are a technical challenge to use safely and don't work for hardwood plywood. Phenolic adhesives work well in structural platforms but can create product quality issues for industrial users, primarily relating to product color, flatness and some other shrink/swell problems. Also, phenolic adhesives require more energy to produce, transport and use, a bad formula in this greenhouse gas, energy sensitive world.

Then there are the industrial supply challenges. Frankly, we couldn't obtain the phenolic and isocyanate adhesives necessary to switch even if we wanted to, due to the built infrastructure and supply chains required to provide them. Last year, the OSB business was given a rude shock and told it could not obtain any more isocyanate adhesives due to a shortage in the global production capacity for that glue. Likewise, switching to a phenolic based system would require a massive capital investment by the industry's adhesive suppliers and changes by the commodity chemical industry that supplies them.

What will it cost to minimize, remove or control formaldehyde to the regulatory emission limits?

- **Phase I (2009)**
 - CARB Estimates: March Staff Report
 - Industry Examples: HUD to EPP reduction
- **Phase II (2011)**
 - CARB Estimates – March Staff Report
 - Industry Estimates: Rule Comments



As for the question about what it will cost to meet the regulatory emission limits, CPA has a different analysis than the one presented by CARB in their March 2007 staff report to the board, but not on the impact of phase 1 of the rule. CARB estimated that phase 1 would increase costs 4 to 7 percent for particleboard and MDF. However, it should be pointed out that this is not an insignificant sum. For example, to switch from a HUD level emission product to CPA's EPP standard, from 0.30 PPM to 0.20 PPM is roughly the same as a switch to Phase 1. One CPA member noted that its estimate for its multi-mill company was that such a switch would cost their company \$1 million per year.

CARB's staff report estimates that phase 2 will increase costs 30% for particleboard and 40% for MDF. CPA believes those estimates are low and made a comment to that effect during the comment period for the rule. Our estimate was that costs would increase by at least 50% for both products. Several of our members indicated that they felt 50% was a conservative estimate and that, for their firms the cost increase would be higher. One thing is clear. When costs rise that much, they will be passed along to composite customers because no one can absorb that level of increased cost and stay in business.

How is formaldehyde measured now and how will that change?

- **Adhesive Suppliers**
 - Adhesive formulation
- **Plant Quality Control**
 - Small Chamber
 - Desiccator
- **Certification Agencies**
 - Large Chamber Test Measurement Chemistry
 - Small Chamber Certification – ANSI Changes



Yesterday I visited the Hexion lab here in Springfield and was reminded about the intense, iterative work that goes on between the resin suppliers and the plants when they are developing a new adhesive. That will be a critical part of the calibration which facilities will undergo in order to meet this rule.

Plant quality control will need to become very precise. Predictability based on plant QC tests is okay today, but reliant on a much larger span of variability, simply based on moving from a .30 PPM to a .11 or .09 PPM standard. Plants may need to move away from 'hot' tests – tests closer to production - to reduce testing variability. Regarding the tests, it is likely that test sampling period will increase. Plants may need to double the time used for small chamber tests in order to increase sensitivity. Desiccator tests may need to adopt the Japanese 24 hour protocol.

Certification agencies like CPA may need to adopt more sensitive measurement technology in order to accurately assess very low emission products. There could be a move away from traditional chromotropic acid chemistry to DNPH based chemistry and liquid chromatography. The use of small chambers might become an option in the next ANSI standard and CARB might allow and even encourage a switch to more frequent or duplicative small chamber tests as an alternative to the large chamber.

How is formaldehyde measured now and how will that change? (Continued)

- **CARB Supplemental Rules/Guidance**
 - Finalized Certification Protocols
 - Opt out provisions
- **CARB Compliance Testing**
 - Screening Tests for Finished Products
 - Research on Destructive Test impact
 - Small Chamber Compliance Tests



This slide features my list of things yet to be done. Hopefully, as I will be following CARB on this agenda, some of what I say will not be completely relevant.

Because CARB has not finalized their certification protocols, there are still some unknowns about exactly we will have to do. Also, the 'opt out' provisions – my term, not CARB's – may impact both the market and what certification agencies do for plants that decide to make a board with emissions so low that CARB exempts them from ongoing quality control requirements.

Another area still under construction is the protocols for the screening tests on finished products. A screening test protocol has been drafted, but how such a protocol will be applied has not been drafted yet. Finished product manufacturers have not begun to do extensive research on the impact of what I term 'destructive' testing on their products. In other words, how do their products behave, emission wise, when you sand the surface veneers or laminates off? Also, CARB has indicated they plan to use a small chamber for compliance tests for raw panels and a protocol has not been developed for those tests either.

Will strength and durability be affected by the changes?

- **PF/ISO Based Products**
 - Unlikely
- **UF Bonded Products**
 - Changes Tied to Finished Product Engineering
 - Cost Considerations
 - Innovation Challenge: Are composites commodities or strategic materials?



We don't see the rule having any impact on the phenolic and isocyanate bonded products from the standpoint of strength and durability. However, these products presently only account for less than one percent of the particleboard and MDF products produced. It can be reasonably anticipated that the market will be growing for non-UF products, however. The demand is currently being driven by the LEED credit for non-UF products. However, as product costs rise for UF based systems because of the CARB requirements, the cost differential will narrow and that could drive demand up.

For UF bonded products, there may be changes tied to finished product engineering and cost considerations, and product innovation. The two largest costs in composite production are adhesives and wood. Logically, if we could use less wood our costs would not rise as much, but that creates an engineering challenge for our customers since they have become dependent on a relatively denser and therefore stronger product. However, a much lighter product is sold in Europe so it is a reasonable assumption to predict that European engineering practices which allow the use of lighter boards are likely to be adopted as the prices for the heavier products become dear.

The bottom line is this. Composites will very shortly become viewed less like traditional commodities and more like strategic materials by composite customers. We have already begun to hear statements to that effect by IKEA, a company noted for its vision in the marketplace. It is also a company heavily dependent on composites.

What are the Estimated Economic Impacts?

- **CWIC Economic Impact Comments on the CARB Rule**
- **Finished Product Cost Example**
 - How raw material cost changes impact finished product costs
- **Composite Manufacturing Challenge**
 - Meeting the challenge through innovation and by providing value



CPA has an ongoing disagreement with the way that CARB evaluates the economic impact of this rule. CARB's estimate is that there is a \$127 million per year impact. First, we believe the costs are likely to be 20% higher than those predicted in the CARB staff report, as we indicated earlier. Second, CARB's analysis does not include the impact of cost increases as they move through the manufacturing chain and the economy. Third, CARB bases their analysis strictly on California impact and the truth of the matter is that this is a rule with national impact. Everyone wants to sell into California. Raw panel producers can not reliably predict where their products will end up and even finished product producers can't be completely sure. Hopefully, most businesses will target 100% compliance with the rule so consequently the demand side alone will give this rule a national and even a global impact.

To our second point on cost increases as products move through the value added chain, I always refer to Sauder Woodworking. They provided a very good example in their comments to CARB on the rule of the impact of panel cost changes on finished product costs to the consumer. The CARB analysis ignores cost increases for finished product producer margins, wholesaler margins and retailer margins. All these increases are percentage based. When those factors are integrated into the economic impact analysis, the impact is more like \$400-500 million in California per year and \$2-3 billion per year in the national economy.

What percentage of your volume of product goes to/thru CA?

- **Composite Panel Sales in CA**
 - California Manufacturing Environment
- **Finished Product Sales in CA**
 - Impact of household formation



California is roughly 11% of the U.S. economy. Only about 7% of the raw particleboard and MDF panels are consumed there. That percentage used to be much higher but because of high costs many manufacturers have elected to leave California over the last few decades.

For finished products or consumer products, however, there is a different story. The number tends to be higher than the national average because the rate of home formation is higher than the national average. I don't have the exact numbers but there are several product groups which are important finished product demand drivers: kitchen cabinets, home furniture, office furniture, laminate flooring and store fixtures. I have heard estimates ranging from 15-20% for the different product groups. Perhaps Bill Perdue has a better number for home furniture. I noticed that Brad Miller is here from the office furniture association. Perhaps he knows what that number is.

Will these regulations likely increase, decrease or not change your market in California?

- **Formaldehyde Issue Regarding Composite Panels Eliminated**
 - Emission Reductions: 60% particleboard; 70% MDF; 85% hardwood plywood
- **Supply of Quality Composite Panels will continue unabated**
- **The future will be different than the past or the present; it always is.**



CPA has several fundamental opinions about the rule.

•First, the reduction in emissions from a level that was already considered low once upon a time will be huge; 60% for particleboard, 70% for MDF and 85% for hardwood plywood. We believe that these massive reductions should eliminate formaldehyde as an issue in composite panels. We believe that the reputation of California as the purveyor of strict environmental rules will reinforce this perception on our part.

•Second, the supply of quality composite panels will continue unabated. As I noted above, it would not surprise us if, working with our customers, new products emerge. There will be a strong demand push to reduce these new higher costs. Lighter products are one likely result. New, customized products are more likely. After all, if customers will be paying more they will be expecting more.

•Last, the future will always be different than the past or the present. It always is. Anticipating change is wise but predicting the future is a fool's game. Consumers have a lot of options on how to spend their money. Hopefully they won't begin to shy away from composite based products because of the cost increases.



Predicting the future is a particularly bad idea when it comes to regulatory activity. As the recent smack down we got from the federal court on the MACT rule shows, government actions can be particularly harsh when they are not expected. Who is to say that California or some other government body won't revisit this issue and come out with a tougher standard in the future? I don't expect it but I would never say that it will not happen.