AP42 Sections:	10.5, 10.6 and 10.9
Title:	Comments and letters regarding *Emission Factor Documentation for AP-42. Chapter 10 Plywood and Composite Wood Products.* Final Background Report July 2003

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Subject: Responses to External Review Comments on Wood Products AP-42 Sections
Plywood and Composite Wood Products MACT-Promulgation
EPA Contract 68-D-01-079, Work Assignment 0-03
MRI Project 110168.1.003

From: Richard Marinshaw

To: Dallas Safriet
EPA/EMAD/EFIG (D205-01)
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Background

The following six draft sections of the Wood Products Industry Chapter of *Compilation of Air Pollutant Emission Factors, Volume I–Stationary Point and Area Sources* (AP-42), were made available for external review on February 7, 2001:

Section 10.5, Plywood Manufacturing;
Section 10.6.1, Waferboard/Oriented Strandboard Manufacturing;
Section 10.6.2, Particleboard Manufacturing;
Section 10.6.3, Medium Density Fiberboard Manufacturing;
Section 10.6.4, Hardboard and Fiberboard Manufacturing; and
Section 10.9, Engineered Wood Products Manufacturing.

Comments were received from Charles Simon, Precision Analytical Laboratories, Incorporated; and David Word, National Council for Air and Stream Improvement, Incorporated (NCASI). The comments and possible responses to the comments were discussed on August 22, 2001 at a meeting attended by Dallas Safriet of the Emission Factor and Inventory Group (EFIG), U.S. Environmental Protection Agency (EPA); Gary McAllister of the Emission Measurement Center (EMC), EPA; Katie Hanks, Midwest Research Institute (MRI); and Richard Marinshaw, MRI. A conference call also was held on October 1, 2001 to discuss some of the issues further. Participating in the conference call were Dallas Safriet, David Word, and Richard Marinshaw. This memorandum summarizes the major comments and the responses to those comments.

Summary of Comments and Responses

The major comments received on the draft AP-42 sections concerned the following issues: reporting of emission factors for volatile organic compounds (VOC's), reporting of emission factors for total particulate matter (PM), reporting emission factors by wood species, excluding data for tests on exhaust streams with high moisture content, carbon dioxide (CO_2) emission factors for non-combustion sources, inclusion of additional test data for plywood veneer dryers, and exclusion of certain test data. The following paragraphs discuss these comments and the recommended responses to those comments based on discussions with you, the August 22, 2001 meeting, and the October 1, 2001 conference call. In addition, the commenters suggested several relatively minor changes to the process description and other text in the AP-42 sections that discusses emissions and controls. With a few exceptions, those changes were made and are not discussed further in this memorandum.

1. Reporting of VOC Emission Factors

Comment: Both commenters disagreed with the manner in which VOC emission factors are reported in AP-42. Mr. Simon suggested using THC analyzer response factors and emission data for the actual species present in the exhaust stream to convert Method 25A data for total hydrocarbons (THC) to VOC emission factors. He noted that, for pines and Douglas firs, the predominant VOC species are terpenes, and, for other firs and hardwoods, the predominant VOC species are acetic acid, acetaldehyde, formaldehyde, and methanol. He presented several examples of how VOC emission factors should be calculated using the following general form:

$$\text{VOC as VOC} = \{\text{M25A THC as C mass} - S_i[(Rf_i)(\text{speciated compound mass}_i)/(MWi/CW_i)]\} \times \{[\text{MW/CW of the dominant non-speciated VOC}]/[Rf]\} + \{S_j[\text{non-exempt speciated compound mass}]\}$$

where:

Rf = M25A per-carbon response divided by the test calibration gas per-carbon response
MW = molecular weight, and
CW = carbon weight.

Mr. Word supported including in AP-42 THC emission factors as carbon but disagreed that a correction factor should be applied for reporting the emission factors as VOC unless the pollutants used in the correction factor are measured concurrently or reasonably close in time. He also stated that, if a correction factor is used, the calculations should account for the response factors for each compound, and corrections should be made on a run-by-run basis.

Response: After much discussion, it was decided that VOC emission factors would continue to be reported on a propane basis with corrections for certain compounds according to the following equation:

VOC as propane = (1.22 × THC as carbon) + formaldehyde - (acetone + methane + methylene chloride)

This method of correction is consistent with EFIG's general procedures for reporting VOC emission factors in AP-42. Although the methods of correcting VOC data suggested by the commenters seemed reasonable, it would be difficult to apply those methods to the wood products industry data due to the lack of data on specific compounds (e.g., the lack of data on acetic acid emissions from hardwood veneer dryers). In addition, the THC analyzer response factor for a specific compound is not necessarily the same for all analyzers. It is noted that the data and spreadsheets used to develop the emission factors presented in all of the AP-42 sections will be made available on EPA's Technology Transfer Network (TTN) website as the AP-42 sections are finalized. Anyone interested in understanding exactly how the data were used to develop emission factors or converting the emission factors to a different basis (e.g., VOC as terpenes) can readily access the data from the TTN.

2. Reporting of Total PM Emission Factors

Comment: Mr. Word suggested that AP-42 include emission factors for total PM by combining the filterable and condensible PM fractions on a run-by-run basis. He indicated that this method would provide more representative emission factors for total PM, and users of AP-42 would not have to combine separate emission factors for filterable and condensible PM to derive an emission factor for total PM.

Response: The EFIG's standard procedure for addressing PM emissions in AP-42 is to present separate emission factors for filterable PM, PM less than 10 micrometers in aerodynamic diameter (PM-10), and condensible PM. Therefore, this format will continue to be used for the wood products industry sections of AP-42. Emission factors for total PM can be determined by combining the emission factors for filterable PM and condensible PM. If emission factors for total PM on a run-by-run basis are desired, test-specific data will be available on the TTN for the necessary calculations as the AP-42 sections are finalized.

3. Reporting Emission Factors by Wood Species

Comment: Mr. Simon stated that VOC emission factors for softwood dryers and presses should be separated into three groups: pines, Douglas firs, and other softwoods. He noted that, because VOC emissions from pine veneer dryers are several times higher than emissions from the drying of other softwoods, it is inappropriate to combine emission factors into one generic softwood category.

Response: To respond to this comment, all softwood dryer and press data were reviewed. Although it would be possible to report separate emission factors by species in some cases, the data largely are inadequate or inconsistent for doing so. For many of the tests, the wood species were not identified (e.g., the furnish was reported simply as "softwoods" or "hardwoods"). For other tests, the wood furnish consisted of a mixture of species. In some

cases, the resulting emission factor would be based on a single emission test, which might be not be representative of most sources. For these reasons, it was decided that emission factors for softwood species should continue to be grouped together and reported as softwoods. Using the data from tests for which the species were not fully identified was preferable to eliminating such data. If the data were eliminated, many of the emission factors would be based on a small number of tests and could be less representative than a more generic softwood emission factor based on several tests. As noted above, the test-specific data will be available on the TTN, if a species-specific emission factor is needed for a certain source. When more data become available, the AP-42 sections can be revised to present emission factors by wood species accordingly.

4. Excluding Data For Tests With High Moisture Content

Comment: Mr Simon stated that THC data for which the moisture content at the analyzer is greater than 20 percent should be discarded because the data are likely to have a negative bias. He also noted that THC data should be discarded if the sampling train included a condenser because some of the VOC would condense and would not be quantified. The resulting bias is particularly significant for hardwood species.

Response: It was decided not to discard the data from tests in which the moisture content exceeded 20 percent. For most of the dryer data used for developing emission factors, the stack gas moisture content exceeded 20 percent; if the results of those tests were discarded, there would be few remaining test reports for developing emission factors. Furthermore, much of the data used to develop the THC and VOC emission factors are from tests conducted by NCASI, and NCASI routinely uses dilution to eliminate potential bias due to high moisture.

Regarding the use of condensers in sampling trains, two THC emission factors were identified that were based on tests on hardwood dryers using condensers in the sampling trains: the emission factor for indirect-heated hardwood OSB dryers and the factor for direct wood-fired hardwood laminated strand lumber dryers. These emission factors were discarded. It should also be noted that most test reports did not provide enough information to conclude whether or not a condenser was used in the sampling train.

5. CO_2 Emission Factors for Non-Combustion Sources

Comment: Mr. Word stated that CO_2 emission factors should not be presented for non-combustion sources because the data simply represent ambient CO_2 concentrations. He noted specifically that presses are not expected to generate CO_2.

Response: Emission factors for CO_2 from presses and indirect-heated dryers were eliminated from the AP-42 sections.

6. Inclusion of Additional Test Data for Plywood Veneer Dryers

Comment: Mr. Simon indicated that the draft AP-42 sections did not include the results from 28 tests performed by one wood products company at 10 of their facilities during the period 1997 to 2000. He also stated that NCASI Technical Bulletin 405 presents the results from Method 25 tests on plywood veneer dryers at two plants that also were not included in the draft plywood AP-42 section. He indicated that these data should also be considered before the AP-42 sections are finalized.

Response: It was decided not to incorporate the results of the 28 emission tests for two reasons. Mr. Simon indicated that the data were in good agreement with the emission factors presented in the draft AP-42 sections. Consequently, we would not expect the emission factors to change significantly if these additional data were to be included. In addition, if the data from the 28 tests were incorporated into the AP-42 sections, another external review of the draft sections would be warranted. It was concluded that it was preferable to finalize the AP-42 sections sooner, rather than hold up finalization to incorporate data that would not significantly change the emission factors.

Method 25 data were not used in preparing the revised AP-42 sections for two reasons: (1) Method 25 data are not comparable to Method 25A data for all sources, and (2) the vast majority of VOC data on file are based on Method 25A tests. Therefore, it was also decided not to include the Method 25 data from NCASI Technical Bulletin 405. Furthermore, Mr. Simon indicated that the Technical Bulletin 405 data are in good agreement with the data presented in the draft AP-42 section for plywood. Also, Technical Bulletin 405, which was published in 1983, contains data for only two plants. Therefore, the emission factors would not be expected to change significantly if the additional data were considered.

7. Exclusion of Certain Test Data

Comment: Mr. Simon suggested eliminating from consideration in AP-42 the data from three tests that were conducted on unenclosed plywood presses because the data are biased low. He also suggested eliminating the results of a test on a tube dryer that was operating under very low production rates because those data also may be biased low.

Response: It was decided not to exclude the data from these tests. Few, if any, plywood presses are enclosed. If the data for unenclosed presses were eliminated, there would be no remaining data for developing emission factors. Regarding production rates, emission factors account for the level of production. Therefore, there is no need to eliminate data from sources that were tested when the source was operating at low (or high) production rates.

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July 5, 2001

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Dear Dallas:

I recently reviewed the plywood sections of the February 7, 2001 Draft Emission Factor Documentation for AP-42 Chapter 10, Plywood and Composite Wood Products and have several comments that I would like to pass along. My discussion will follow the order of your document for easier reference. My comments are limited to plywood VOC emissions for the most part, but some comments are generally applicable to all wood product source emissions.

III.B.1. Pollutants and Emission Measurements, Non-HAP data, Organic Compounds paragraph -4

Past M-25 VOC test data for pine species, expressed as carbon, are directly comparable to M25A data expressed as carbon and corrected for response factors. For terpene emissions measured with low moisture at the analyzer, the M25A response factor is ~1.0. So, for these measurements the data are directly comparable. These cover nearly all M25A tests performed by NCASI and contractors using dilution probes for high moisture sources, and without dilution probes for low moisture sources, on facilities processing pine species. Filter temperature for pine veneer dryer exhaust was shown not to affect VOC measurements between the tested rage of 190-350°F.

In 1983, NCASI TB 405 reported an average s. pine veneer dryer VOC emission rate of ***2.6 lb*** as carbon/MSF(3/8") using Method-25. Two mills were tested.

In 1999, NCASI TB 768 reported an average s. pine veneer dryer VOC emission rate of ***2.8 lb*** as carbon/MSF(3/8") using Method-25A with a heated-air dilution probe and propane/air calibration gas. Moisture content of the diluted gas at the analyzer was <10% in all tests. Three mills were tested.

From 1997-2000 Georgia Pacific performed 28 stack tests at *ten* mills on s. pine veneer dryer RTO performance. Inlet and outlet tests were performed using Method-25A with a dilution probe and propane calibration gas. The average inlet loading rate to the RTO (equal to uncontrolled emissions) ***2.7 lb*** as carbon/MSF(3/8"). A summary table is attached. (Some minor corrections are listed for some of the test results to account for quantifiable biases, based on NCASI analyzer performance studies.) Copies of the stack test reports are in EPA's possession and can be provided for your review and file.

These three data sets have an incredibly close match. This is not a coincidence. All of the tests included in these data sets were performed accurately and can be relied on to provide the most accurate average emission factor for s. pine veneer dryers available today. Also, for reference, the average Georgia Pacific RTO outlet VOC emission rate at the ten mills was 0.07 lb as C/MSF(3/8").

Under this same topic, NCASI studied the effect of moisture on M25A analyzers and found substantial negative biases with all analyzers at moisture contents >20%. Some analyzers had significant biases at moisture levels of 10-20%, but no analyzers seem to have significant biases at moisture contents <10%. All M25A stack test data that you include should have <20% moisture at the analyzer. This is a relatively easy thing to check in the stack test reports. A discussion of this effect should be included in Section II.B.3. Beware of tests where condensers were used to remove moisture for the gas stream prior to the M25A analyzers. These tests are invalid because some portion of the VOC will be lost in the condenser.

paragraph –6 --- conversion of THC to VOC

To accurately convert the M25A THC as carbon signal to VOC, the actual compounds present in the gas stream must be known or asserted with confidence. The response factors of these compounds on the M25A analyzer versus the calibration gas used for the test must be ascertained. These are not just good ideas, they are requirements.

Each emitting facility (and their contractors) is responsible for collecting all relevant information used to accurately determine the air pollutant emission rates of their existing sources. They are also responsible for collecting all relevant information used to accurately estimate air pollutant emission rates from proposed sources. AP-42 is relied upon heavily by Industry for both purposes.

For pines and Douglas firs the predominant VOC are known to be terpenes. The average molecular weight to carbon weight ratio for terpene is 1.134. The approximate M25A response factor for terpene in dry air versus propane in dry air is 1.0.

For non-terpene bearing woods (other firs, hardwoods and soft-hardwoods), the predominant VOC are acetic acid, formaldehyde, methanol and acetaldehyde. The average molecular weights to carbon weight ratios for these compounds are 2.50, 2.50, 2.67 and 1.83, respectively. The approximate M25A response factors for these compounds versus propane-in-air are 0.6, <0.1, 0.7, 0.8, respectively.

Some exempt organic compounds are also present in wood processing source emissions. These are known to be methane, acetone and dichloromethane. The average molecular weights to carbon weight ratios for these compounds are 1.33, 1.61, and 6.92, respectively. The approximate M25A response factors for these compounds versus propane-in-air are 1.1, 0.8, and 0.5, respectively.

The M25A THC as carbon signal for terpene-bearing species (pines and Doug firs) must first be corrected for the portions of acetic acid, formaldehyde, methanol and acetaldehyde, methane, acetone and dichloromethane detected, then the remaining THC as carbon value is multiplied by 1.134 to convert it to terpene. Next, the mass emission rates of acetic acid, formaldehyde, methanol and acetaldehyde are added to the terpene emission rate. This yields the total VOC emissions expressed "as VOC".

Four examples of the conversion equations are given below. Three examples rely on information taken from NCASI TB 768, Table 7.1.1 "Summary of Plywood Results –Average Values", and one example relies on data from Table 5.2.1 "Dryer Emissions, Douglas Fir Furnish Mill 112". The first example is for western softwood (predominantly Doug fir) veneer dryers, the second example is for southern softwood (all s. pines) veneer dryers, the third example is for average hardwood veneer dryers, and the fourth example is for a Doug Fir veneer dryer. All of these examples use the approximate M25A response factors listed above. The response factor for formaldehyde is assumed to be zero.

NCASI TB 768 Western Softwood Veneer Dryer Average Values (all values in lb/MSF$_{[3/8"]}$)

Acetaldehyde = 0.02

Formaldehyde = 0.02

Methanol = 0.04

M25A THC as C = 0.56

VOC = {0.56 – [(0.02)(0.8)/1.83 + (0.02)(0.0)/2.50 + (0.04)(0.7)/2.67]} {1.134/1.0} + 0.02 + 0.02 + 0.04

= 0.69 lb VOC as terpene, acetaldehyde, formaldehyde and methanol/MSF$_{[3/8"]}$

NCASI TB 768 Southern Softwood (pines) Veneer Dryer Average Values (all values in lb/MSF$_{[3/8"]}$)

Acetaldehyde = 0.01

Formaldehyde = 0.01

Methanol = 0.04

M25A THC as C = 2.80

VOC = {2.80 – [(0.01)(0.8)/1.83 + (0.01)(0.0)/2.50 + (0.04)(0.7)/2.67]} {1.134/1.0} + 0.01 + 0.01 + 0.04

= 3.21 lb VOC as terpene, acetaldehyde, formaldehyde and methanol/MSF$_{[3/8"]}$

NCASI TB 768 Hardwood Veneer Dryer Average Values (all values in lb/MSF$_{[3/8"]}$)

Acetaldehyde = 0.004

Formaldehyde = 0.001

Methanol = 0.04

M25A THC as C = 0.30

VOC = {0.30 – [(0.004)(0.8)/1.83 + (0.001)(0.0)/2.50 + (0.04)(0.7)/2.67]{2.50/0.6} + 0.004 + 0.001 + 0.04

= 1.24 lb VOC as acetic acid, acetaldehyde, formaldehyde and methanol/MSF$_{[3/8"]}$

NCASI TB 768 Mill 112 Douglas Fir Veneer Dryer Average Values (all values in lb/MSF$_{[3/8"]}$)

Acetaldehyde = 0.0031

Acetone = 0.0041 (exempt compound, MW/CW = 1.61, M25 Rf ~0.8)

Formaldehyde = 0.0065

Methanol = 0.064

M25A THC as C = 0.83

VOC ={0.83 – [(0.0031)(0.8)/1.83 + (0.0041)(0.8)/1.61 +(0.0065)(0.0)/2.50 + (0.064)(0.7)/2.67]} {1.134/1.0}

+ 0.0031 + 0.0065 + 0.064

= 0.99 lb VOC as terpene, acetaldehyde, formaldehyde and methanol/MSF$_{[3/8"]}$

All of the above equations have the general form:

VOC as VOC = {M25A THC as C mass – Σ_i[(Rf$_i$)(speciated compound mass$_i$)/(MWi/CW$_i$)]}

x {[MW/CW of the dominant non-speciated VOC]/[Rf]}

+ {Σ_j[non-exempt speciated compound mass]}

where:

Rf = M25A per-carbon response divided by the test calibration gas per-carbon response

MW = molecular weight and

CW = carbon weight

In practice, only methanol and formaldehyde are present in panelboard manufacturing source emissions in amounts that are (sometimes) worth considering. (There are a few exceptions to this, most notably in the hardboard manufacturing sector where acetaldehyde and acrolein have been found in significant proportions).

If only methanol and formaldehyde are considered, the above equation reduces to:

For terpene-bearing wood species, and a terpene Rf of 1.0:

VOC as VOC = [M25A THC as C mass – (methanol mass)(0.7)/2.67)] x [1.134]
+ formaldehyde mass + methanol mass

= [M25A THC as C mass][1.134] – [(methanol mass)(0.7)/2.67][1.134]
+ formaldehyde mass + (1.000)(methanol mass)

= [M25A THC as C mass][1.134] – (methanol mass)(0.297) + (1.000)(methanol mass)
+ formaldehyde mass

= [M25A THC as C mass][1.134] + (methanol mass)(0.703) + formaldehyde mass

For non-terpene bearing wood species, and an acetic acid Rf of 0.6:

VOC as VOC = [M25A THC as C mass – (methanol mass)(0.7)/2.67)] x [2.50/0.6]
+ formaldehyde mass + methanol mass

= [M25A THC as C mass] [2.50/0.6] – (methanol mass)(0.7)/2.67)(2.50/0.6)
+ (1.000)(methanol mass) + formaldehyde mass

= [M25A THC as C mass] [2.50/0.6] – (methanol mass)(1.092) + (1.000)(methanol mass)
+ formaldehyde mass

= (M25A THC as C mass)(4.17) - (0.092)(methanol mass) + formaldehyde mass

III.B.2. Pollutants and Emission Measurements, Non-HAP data, Moisture Content of Dryer Exhaust

It would be appropriate to discuss the negative bias moisture can have on M25A THC measurements. A summary of the NCASI study would be very helpful. I recommend (and use) M25A with appropriate *heated-air dilution to <10% moisture*, and *propane/air calibration gases*. NCASI does the same thing. We are trying to get all Consent Decree compliance contractors to do the same thing (and most are). NCASI officially designates 20% as the maximum tolerable moisture content before significant negative bias occurs. However, the NCASI study showed ~20% negative bias at 20% moisture for some M25A analyzers. NCASI routinely dilutes M25A sample gas streams to ~5% moisture in their field studies.

III.B.3. Pollutants and Emission Measurements, Non-HAP data, VOC and PM-10 measurements Paragraph 3

The earlier M25 tests on veneer dryer VOC emissions reported in NCASI TB 405 used heated filter temperatures of 190°F and 300°F, and in-stack filters at temperatures of ~300-350°F. The results clearly showed no discernible difference in M25 VOC emission measurements at the two filter temperature extremes *for pine species*. The M25 VOC measurements of pine veneer dryer emissions reported in NCASI TB 405 are accurate, directly comparable to recent pine veneer dryer VOC emission measurements, and should be included in the current AP-42.

Paragraph 4

I suggest you eliminate all M25A THC data that were measured at >20% moisture at the analyzer. Beware of tests where condensers were used to remove moisture form the gas stream prior to the M25A analyzer. Any such tests are *invalid*.

Please make a clear statement that the portion of VOC that can also be measured as condensable particulate matter (CPM) *is VOC.*

Other Comments

My last major comment concerns the listing of VOC emission data. The Softwood category really needs to be broken out to pines, Doug firs, and other softwoods. It may not be necessary to break out the HAP data by species, but *the VOC data really need to be listed by species*. It is clear that pine veneer dryer VOC emissions are several times higher than emissions from other softwoods. I suggest one additional Table of just THC/VOC emissions for veneer dryers by species, and one additional table for THC/VOC emissions for plywood presses by species and resin type.

References 78 - The emission tests at Emerson, AR were performed on an unenclosed press. Emission factors are biased low.

References 79 – Some M25A tests at Emerson, AR were performed under high moisture conditions. Emission factors are biased low.

References 88 - The tube dryer emission tests at Eugene, OR were performed under very low production rates. Emission factors may be biased low.

References 89 - The emission tests at Eugene, OR were performed on an unenclosed press. Emission factors are biased low.

10.5.2 Moisture contents in dry veneer now range up to ~25% for "face" panels.

10.5.2 Regular veneer dryers are used for redry at many mills. The redry is run through the dryer much faster than green veneer.

10.5.3 There are fugitive VOC emissions from debarking and log peeling operations as well as the other minor sources listed.

The predominant VOC in hardwood veneer dryer emissions appears to be acetic acid (NCASI TB 718). The conversion of M25A THC as carbon to VOC emissions requires multiplying the "as carbon" value by 4.17, which results in substantially higher "VOC" emissions than conversion to "propane".

Table 10.5.-2.
Refer to the CO and NOx emission data from GP compliance tests on veneer dryer RTOs at six different mills. Average CO emissions were 0.29 lb/MSF(3/8"). Average NOx emissions were 0.0015 lb/MSF(3/8").

Table 10.5.-3.
The Softwood THC/VOC data really need to be broken out to pines, Doug firs, and other softwoods. It may not be necessary to break out the HAP data by species, but the THC/VOC data need to be listed by species. It is clear that pine veneer dryer VOC emissions are several times higher than emissions from other softwoods. I suggest one additional Table of just THC/VOC emissions for veneer dryers by species.

Please include the GP compliance test VOC data for s. pine veneer dryers. RTO inlet emissions are equivalent to uncontrolled emissions.

Table 10.5.-6. Two 1992 tests at Weyerhauser facilities reported average s. pine press vent VOC emissions of 0.43 and 0.75 lb as terpene/MSF(3/8"). The presses were reasonable enclosed and proper M25A tests were performed. Methanol and formaldehyde emissions were not tested. These are the only tests where condensers were not used ahead of the M25A analyzers.

Sincerely,

Charles G. Simon

Charles G. Simon, Ph.D.
Senior Scientist

Cc. Dianne Shawley, USDOJ-ENRD
Karl Fingerhood, USDOJ-ENRD

Laxmi Kesari, USEPA-OECA
Linda Lay, USEPA-OECA

Summary of Charles Simon's Comments and Potential Action Items

1. VOC emissions must be reported as VOC for NSR/PSD. AP-42 should also report VOC as VOC. He provides equations for conversion of THC (as C) to VOC "as terpenes" for pines and Douglas fir and to VOC as "acetic acid" for other firs, hardwoods, and other softwoods.

Background report says we used VOC as propane because of EFIG guidance. NCASI would prefer to have no VOC numbers in AP-42. We would need their buy-in before we include Charles' VOC calculations.

We could report VOC as propane and again as VOC as Charles suggests but this would be very confusing for States. Instead, we could describe Charles' method of calculating VOC in the background report as another option.

Any change in VOC calculations would need to be made to all six sections, not just to plywood section. We would have to decide whether to report VOC "as acetic acid" or "as terpenes" for these mixed species dryers.

Are Charles' response factors for the various compounds correct?

2. Charles has 28 new M25A stack tests for RTO inlet/outlet on veneer dryers 10 Georgia-Pacific southern pine plywood plants. CO and NOx data are available for veneer dryer RTO's at 6 plants.

Do we want this data for incorporation into AP-42? He seems willing to send it to us.

NCASI would likely want to review the test reports and/or revised emission factors.

3. The "softwood" category needs to be broken into 3 categories for VOC: pines, Douglas firs, and other softwoods. He suggests an additional table of just THC/VOC data broken into the 3 species groups for veneer dryers. He also suggests an additional table for THC/VOC for plywood presses grouped by species and resin type.

NCASI did not comment on the equipment groupings.

If we break out VOC into 3 categories for the plywood section, would we have to do so in the other AP-42 sections?

The detail spreadsheets are set up for the "softwood" grouping and correspond with the summary sheets. The sheets cannot be set up for both a "softwood" category and for 3 categories of VOC and still correspond with the summary sheets. We would need to develop a new set of corresponding spreadsheets/summary sheets for the 3 categories of VOC (1-2 days of work for plywood section).

4. We should include the M25 data in NCASI TB 405 because the M25 data are comparable to M25A data for other southern pine veneer dryers.

We can ignore this comment if we do not further break out veneer dryers by species.

We made the decision to discard M25 data for all sources because M25 and M25A data are not comparable for all sources (i.e., those emitting oxygenated compounds). The universe of M25A data is much larger than the universe of M25 data. If we include M25 data from the NCASI TB 405 for southern pine veneer dryers, we would have to reconsider including M25 data for other sources. Charles also notes that the NCASI TB 405, which was published in 1983, contains data for only two plants.

5. All M25A data should have <20% moisture at the analyzer or be discarded. A discussion of the moisture effects should be included in II.B.3 of the background memo. Tests where condensers were used are invalid because some VOC condenses.

Lots of stack moistures exceed 20%.

We do not have the old AP-42 test reports which would be needed to check stack moistures.

We would need a copy of the NCASI study he refers to with the moisture corrections for 10 to 20% moisture. NCASI would want another chance to review the sections if we adjust the emissions factors up.

6. He has some comments about specific plywood and MDF tests that yielded biased low emission factors because the press was unenclosed, testing was done under high-moisture conditions, or at low production. He also mentions that condensers were used ahead of M25A analyzers on all but two of the tests used to develop the softwood plywood press vent emission factors (condensers bias the THC data low).

Do we want to discard the data he says is biased low?

7. Make clear statement in III.C.4 that a portion of the VOC that can also be measured as CPM is VOC. He also has some minor comments on the AP-42 section text.

We can try and figure out how to make the requested wording changes.

Plan for Responding to Industry Comments on Wood Products AP-42

NCASI and Charles' comments on calculation of VOC

Stick with VOC as propane because this has been EFIG policy when we are not certain of the most predominant compound present in an exhaust stream.

We have no acetic acid data to know whether Charles is correct in stating that acetic acid is the predominant compound in firs (other than Douglas fir), hardwoods, and other softwoods.

We will not follow NCASI's suggestion to calculate VOC on a run-by-run basis because of the extraordinary amount of work that would be involved.

We will not follow NCASI's suggestion to incorporate the responses factors and propane adjustment into the acetone, methane, and methylene chloride measurements. In many cases we do not have acetone, methane, and methylene chloride data to subtract, and when available, the amount subtracted is very small. Furthermore, there are different response factors for different analyzers.

We plan to make available the detailed spreadsheets so facilities can group and recalculate emission factors however they choose.

Charles' 28 M25A test reports for veneer dryers

We do not want this data because inclusion of the data would necessitate further industry review of the plywood section. We have to cut things off somewhere. Charles indicated in his comments that there was good agreement between the 28 test reports and currently available data.

Charles' suggestion to break the "softwood" category into: (1) pines, (2) Douglas firs, and (3) other softwoods for VOC.

We will consider breaking the softwood category into (1) pines and (2) other softwoods (including Douglas firs) for all sources in the six AP-42 sections. We will first check to make sure such groupings make sense and do not shrink our data sets unreasonably. For the data sets that will not be too small, we will check to make sure it is appropriate to combine Douglas firs and other softwoods. We will also check to confirm there is no reason to break each HAP into the two categories. We will add additional table(s) to the AP-42 sections where we decide to breakout softwoods; the tables will contain THC (as C) and VOC as propane. In order to create the tables, we would create new spreadsheets with the values for THC (as C), formaldehyde, acetone, methane, and methylene chloride. We would group by pollutant and species and then develop a new summary sheet that displays the average emission factors which would be used to calculate VOC as propane.

We expect it will take around 40 hours to examine and break the softwood category into two

categories. Of this 40, it will take about 8 hours to decide which sources need to be broken out (not including any statistical t-tests). This is a significant portion of the funds we have to spend by the end of September.

Charles' comment that we should include the M25 data in NACSI Technical Bulletin 405 because the data are comparable to M25A.

We made the decision to discard M25 data for all sources because M25 and M25A data are not comparable for all sources (i.e., those emitting oxygenated compounds). The universe of M25A data is much larger than the universe of M25 data. If we include M25 data from the NCASI TB 405 for southern pine veneer dryers, we would have to reconsider including M25 data for other sources. Charles also notes that the NCASI TB 405, which was published in 1983, contains data for only two plants.

Charles' comments regarding moisture and condensers.

Charles commented that all M25A data should have <20% moisture at the analyzer or be discarded and tests where condensers were used are invalid because some VOC condenses.

We will note that we probably have some THC data that are biased low due to high moisture. However, we will not throw out all data above 20% moisture because much of the THC data we have is for sources with more than 20% moisture in the stack.

Much of our data is NCASI data. NCASI routinely uses dilution to avoid moisture bias.

Hardwoods tend to produce more water soluble compounds than softwoods. Therefore, use of condensers (which could condense some of the VOC) with M25A is more of a concern for hardwoods than for softwoods. We will check to see how many non-NCASI, M25A test reports for hardwoods with high moisture we would need to look through to determine whether condensers were used.

Charles' comments about eliminating certain test reports

We will not eliminate test reports for unenclosed presses. No plywood presses are enclosed; therefore, all plywood press data would disappear. We likely have data for unenclosed presses in all industry sectors. Uncontrolled presses typically are not enclosed; therefore, much of the uncontrolled press data would disappear. It would be time consuming to determine which presses were enclosed and which were not. This would involve a search of the files for the MACT project and judgements about when the enclosure was installed relative to each test date.

We will not eliminate the specific tests he mentions done under high moisture conditions because we are not going to check all test reports for high moisture conditions.

We will not eliminate the specific tests done at low production. We have not screened any other test reports for low production. Such screening is not necessary because emission factors already

account for production.

We will not eliminate the softwood plywood press tests that involved condensers because we are not screening softwood sources for condensers.

Miscellaneous comments from Charles on background report and plywood section text

We will try and incorporate his suggestions, as appropriate.

NCASI general comment regarding CO2

Agree. We will eliminate CO2 emission factors for non-combustion sources (i.e., indirect-fired dryers and presses)

NCASI general comment regarding total PM

Disagree. We will continue to separate emission factors for filterable PM, filterable PM-10, and condensible PM. This is how we have done in past AP-42 sections.

We will not follow NCASI's suggestion to calculate total PM on a run-by-run basis because the extraordinary amount of work that would be involved.

Miscellaneous NCASI comments on specific tables in the AP-42 sections

Agree. We will most likely incorporate all of these comments after looking into them to make sure they make sense.

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August 14, 2001

Mr. Dallas W. Safriet
U. S. Environmental Protection Agency
Emission Inventory Branch (MD-14)
Research Triangle Park, NC 27711

Dear Dallas:

This letter provides comments on draft AP-42 Sections 10.5, 10.9, 10.6.1, 10.6.2, 10.6.3 and 10.6.4. General comments, applicable to all sections, are provided as well as a few comments that are specific to certain sections or tables.

EPA's AP-42 group has done a good job in taking a large body of emissions and process data and organizing them for use by industry and regulatory personnel. We appreciate the careful work that has been done and the care that has been taken to segregate the data by such process variables as wood species and dryer firing type. You have thoroughly documented the data and provided spreadsheets so that individual run sets can be evaluated. We appreciate the level of detail that you have provided in the spreadsheets and background documents.

General Comments

We see little value in providing carbon dioxide emission values for non-combustion sources. In effect these values represent ambient levels of carbon dioxide. Hot presses are not expected to generate carbon dioxide. But carbon dioxide will be present in press exhaust, since there is carbon dioxide in the atmosphere. Presses are typically exhausted by bringing ambient air from the building past the press. Emissions from the press are "swept into" the flow of building air and exhausted.

As an example, at a typical ambient level of 250 ppm of carbon dioxide, and a typical press flow rate of 100,000 dscfm, a press exhaust would include 240 lb/hr of carbon dioxide. At a production rate of 24 MSF 3/8 per hour, the carbon dioxide emissions would represent about 10 lb/MSF 3/8. Compare this value to the carbon dioxide values for uncontrolled OSB presses of 5.2, 8.3. and 17.0 lb/MSF 3/8 as provided in Table 10.6.1-5.

NCASI has submitted comments in the past concerning how we think VOCs should be reported and expressed. We continue to believe that reporting uncorrected Method 25A results, expressed as carbon, is the most appropriate and consistent approach for reporting of VOC emissions from sources that emit variable mixtures of gaseous organic compounds. We

appreciate the fact that THC as carbon values are presented in the AP-42 tables. Although we do not think it is necessary to apply a correction formula to Method 25A measurements, we do have comments on the formula presented in the AP-42 wood product sections for calculating VOCs as propane.

The formula used is as follows: VOCs as propane = (1.22 x THC as carbon) + formaldehyde – (acetone + methane + methylene chloride). We have concerns about application of this formula to a single sample run as well as concerns about use of the formula based on emission factors.

Any formula that corrects field measurements of VOCs based on addition or subtraction of additional compounds should be calculated only if the pollutants used in the equation are measured concurrently or reasonably close together in time. For example, methane measurements from a dryer operating in March should not be used to correct THC values obtained in November. Further, using this same example, methane measurements made on one set of dryers should not be used to correct THC measurements made on a second set of dryers. We think it is improper to use emission factors in this manner. Adjustments should be made at the individual run level and then the adjusted values may be averaged for an emission factor.

If the formula is applied to a single sample run in which THC is measured by Method 25A and one or more of the other compounds are measured, then it is improper to subtract the full mass emission rate of acetone, methane, or methylene chloride from the THC measurement. Using acetone as an example, first one should determine the amount of acetone measured by the THC analyzer (using the response factor for acetone), second the calculated amount of acetone measured should be adjusted to a propane basis, and third acetone, expressed as propane, should be subtracted from the VOC value.

We have similar comments about treatment of particulate matter emission factors. Factors for total particulate matter should be developed from individual sample run measurements in which filterable and condensable particulate matter fractions were collected. Such a sample run provides filterable, condensable, and total particulate matter measurements. Separately derived emission factors (based on averages) for condensable particulate matter and filterable particulate matter should not be combined to obtain a factor for total particulate matter. It appears that AP-42 has chosen to provide separate condensable and filterable values but not provide a total particulate matter value. By default, you are asking the user to combine factors. We think that you should use the total particulate matter data you have to develop separate emission factors for total particulate matter.

Table 10.6.4-3

We think the Hardboard Press Preheater data should be removed from this table. This production unit was not tested as a separate source. Rather, emissions were tested before and after the preheater exhaust combined with the dryer exhaust and the preheater emissions were calculated by subtracting one sample location from the second. Although this calculation is theoretically sound, we thought it involved too many sources of error, and we did not present the predryer emissions separately in Technical Bulletin 773.

We also think that the "Fiberboard, board dryer, indirect heat, 6-12% asphalt binder, fugitive emissions, softwood" data should be removed. Although NCASI did present these emissions as fugitive dryer emissions in Technical Bulletin 773, we would not necessarily consider these emissions typical of those emitted from fiberboard dryers. The mill tested is one of the oldest panel plants in the U.S. and it is unlikely that fugitive emissions from this dryer are representative of the fiberboard industry as a whole.

Table 10.6.4-9

The "Hardboard former, wet, PF resin" and "Fiberboard former, wet, PF resin" headings should be changed to read "Hardboard former vacuum system, wet, PF resin" and "Fiberboard former vacuum system, wet, PF resin." NCASI did a poor job in describing these sources, and we apologize for the problem. The actual sources tested were the vacuum pumps that remove water from the forming section of the production line. The term "former vacuum system" will result in less confusion.

The methanol value shown in the draft table should be 0.054 rather than 0.54 (see the Sum-Misc worksheet, cell J76, spreadsheet AP-42HB-FB_data.xls).

Table 10.6.2-3

For the "Rotary Dryer, direct wood fired, softwood" section, please check the submitted report for methane. It would be unusual for 0.26 lb/ODT of methane to be present in the exhaust of a wood fired dryer. Further, even if the data are correct, the methane correction (to VOCs as propane) should be applied to the individual sample runs in which methane was measured and not applied to the entire data set (see rows 1058, 1059, 962, and 963 of the "Rotary Dryer" worksheet of the AP-42PB_data.xls spreadsheet).

Table 10.6.2-6

This comment is similar to the one directly above. A methane value is shown for a "Hot press, UF resin." Presses are indirectly heated, thus methane emissions are not expected from presses. If not deleted, corrections to VOCs as propane values should be made only to the runs in which methane was measured.

Table 10.6.2-7

The flaker/refiner/hammermill THC and VOCs as propane values are appropriate for pine or mixed pine (softwood and mixed softwood) only. The values provided will likely greatly exceed emissions from flakers, refiners, or hammermills utilizing hardwoods.

Table 10.5-3

Although marked "Use with caution," we think the data provided for "Indirect heated, fugitive emissions from dryer ends and doors, softwood" should be removed. We are concerned that these data may not be representative of typical dryer fugitive emissions.

Table 10.6.3-7

The data provided for the saw in this table are correct, but will most likely be misunderstood. The source is a saw and hogger that cuts material from finished panels and then "hogs" or pulverizes the trimmed material so it can be used as a fuel. Table 4.2.5 in Technical Bulletin 770 provides the MSF/hr into and out of the saw reclaim system. The MSF used in your calculations for the emission factors, however, is the MSF/hr of reclaim (or trim). The emission factors need to be footnoted or in some way marked so that the user will know that the MSF of trim (not the MSF of the full panels) should be used relative to these emission factors. Note that NCASI, in Technical Bulletin 770, chose to use lb/ODT as the production based emission basis, but these units would also have to be explained, as the ODT refers to the oven dry ton of material actually trimmed off and hogged.

We greatly appreciate the chance to review these AP-42 sections and provide comments. If you have any questions or if I can help you in any way, please contact me.

Sincerely,

David H. Word

David H. Word, Ph.D.
Program Manager

cc: John Pinkerton
Tim Hunt

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FACSIMILE TRANSMITTAL SHEET

TO: Dallas Sapriet

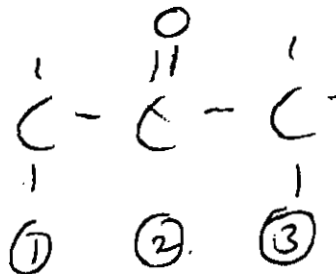
FROM: David Word DATE: 7/31/01

FAX NO.: (919) 541-0684 TOTAL NO. OF PAGES INCLUDING COVER: 4

NOTES/COMMENTS:

Dallas:

Acetone has this structure. The ① & ③ carbon respond fully. The ② carbon does not respond at all.



The ECN = 2 and Response Factor = 2/3 = 67%. Note from attached that the Measured & Empirical ECNs are very close for acetone. (Note the ② carbon is a Carbonyl Carbon with a ECN of Zero).

(2) ECNs, effective carbon numbers, are a means by which one can estimate the response of a compound in a flame ionization detector (which has been calibrated with a straight-chain hydrocarbon or alkane, such as methane or propane). Empirical ECNs are based on values similar to those in Table 1.

(3) RFs, response factors, may be calculated from ECNs as follows:
RF = (ECN/No. carbon atoms in compound) * 100

Example: For Butanol the empirical ECN is 3.0 and the number of carbon atoms is 4. The response factor then is (3/4) * 100 = 75%. Thus, if you have 25 ppm of butanol in a certified bottled gas, which is 100 ppm butanol expressed as carbon, theoretically an analyzer calibrated with methane would read 75 ppm. (Note that an analyzer calibrated with propane would not read 75 ppm, but would read 25 ppm as propane).

Butanol has the formula CH3-CH2-CH2-CHO. The first three carbons are aliphatic carbons and each has an ECN of 1.0 (see Table 1). The fourth carbon, a carbonyl carbon, does not respond in a FID and has an ECN of 0.0 (see Table 1). The total ECN for the compound is 1+1+1+0 = 3. Note that the carbonyl group affects only the one carbon atom that is associated with that group.

(4) Ethanol has the formula CH3-CH2OH. Ethanol, like methanol, is a primary alcohol. Table 1 provides an ECN of either –0.5 or –0.6 for an oxygen atom associated with a primary alcohol group. Using the value of –0.5, the ECN for Ethanol is 1+(1-0.5) = 1 + 0.5 = 1.5. Note the empirical and measured ECNs for ethanol are not equal (see Table 2). The discrepancy between empirical and measured ECNs for methanol is even greater.

The estimated response factor for ethanol would be approximately (1.5/2) * 100 = 75% (see equation in step (3) above). Ethanol at 50 ppm (expressed as ethanol or some other two carbon compound) is 100 ppm expressed as carbon. If a 50 ppm ethanol standard gas were tested on an FID calibrated with methane, the measured value would be approximately 75 ppm.

References:

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(5) Sternberg, J. C., Gallaway, W. S., and Jones, D. T. L. 1962. In: *Gas Chromatography*. New York: Academic Press.

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