UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES, AND
TOXIC SUBSTANCES

January 25, 2007

MEMORANDUM

SUBJECT: Transmittal of Meeting Minutes of the FIFRA Scientific Advisory Panel Meeting Held November 15 - 16, 2006 on Studies Evaluating the Impact of Surface Coatings on the Level of Dislodgeable Arsenic, Chromium and Copper from Chromated Copper Arsenate (CCA)-Treated Wood

TO: James J. Jones, Director
Office of Pesticide Programs

FROM: Joseph E. Bailey, Designated Federal Official
FIFRA Scientific Advisory Panel
Office of Science Coordination and Policy

THRU: Steven Knott, Executive Secretary
FIFRA Scientific Advisory Panel
Office of Science Coordination and Policy

Clifford J. Gabriel, Director
Office of Science Coordination and Policy

Attached, please find the meeting minutes of the FIFRA Scientific Advisory Panel open meeting held in Arlington, Virginia on November 15 - 16, 2006. This report addresses a set of scientific issues being considered by the Environmental Protection Agency pertaining to studies evaluating the impact of surface coatings on the level of dislodgeable arsenic, chromium and copper from chromated copper arsenate (CCA)-treated wood.

Attachment

cc:

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SAP Minutes No. 2007-02

A Set of Scientific Issues Being Considered by the Environmental Protection Agency Regarding:

Studies Evaluating the Impact of Surface Coatings on the Level of Dislodgeable Arsenic, Chromium and Copper from Chromated Copper Arsenate (CCA)-Treated Wood

November 15 - 16, 2006
FIFRA Scientific Advisory Panel Meeting
held at the
Environmental Protection Agency Conference Center
Arlington, Virginia

Notice

These meeting minutes have been written as part of the activities of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), Scientific Advisory Panel (SAP). The meeting minutes represent the views and recommendations of the FIFRA SAP, not the United States Environmental Protection Agency (Agency). The content of the meeting minutes does not represent information approved or disseminated by the Agency. The meeting minutes have not been reviewed for approval by the Agency and, hence, the contents of these meeting minutes do not necessarily represent the views and policies of the Agency, nor of other agencies in the Executive Branch of the Federal government, nor does mention of trade names or commercial products constitute a recommendation for use.

The FIFRA SAP is a Federal advisory committee operating in accordance with the Federal Advisory Committee Act and established under the provisions of FIFRA as amended by the Food Quality Protection Act (FQPA) of 1996. The FIFRA SAP provides advice, information, and recommendations to the Agency Administrator on pesticides and pesticide-related issues regarding the impact of regulatory actions on health and the environment. The Panel serves as the primary scientific peer review mechanism of the Environmental Protection Agency, Office of Pesticide Programs (OPP), and is structured to provide balanced expert assessment of pesticide and pesticide-related matters facing the Agency. FQPA Science Review Board members serve the FIFRA SAP on an ad hoc basis to assist in reviews conducted by the FIFRA SAP. Further information about FIFRA SAP reports and activities can be obtained from its website at http://www.epa.gov/scipoly/sap/ or the OPP Docket at (703) 305-5805. Interested persons are invited to contact Joseph E. Bailey, SAP Designated Federal Official, via e-mail at bailey.joseph@epa.gov.

In preparing the meeting minutes, the Panel carefully considered all information provided and presented by EPA and the Consumer Product Safety Commission (CPSC) staff, as well as information presented by public commenters. This document addresses the information provided and presented by EPA and the CPSC staff within the structure of the charge.

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Steven G. Heeringa, Ph.D.
FIFRA SAP Chair
FIFRA Scientific Advisory Panel
Date: January 25, 2007

Joseph E. Bailey
Designated Federal Official
FIFRA Scientific Advisory Panel
Date: January 25, 2007

Federal Insecticide, Fungicide, and Rodenticide Act
Scientific Advisory Panel Meeting
November 15 - 16, 2006

Studies Evaluating the Impact of Surface Coatings on the Level of Dislodgeable Arsenic, Chromium and Copper from Chromated Copper Arsenate (CCA)-Treated Wood

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INTRODUCTION

The FIFRA Scientific Advisory Panel (SAP) has completed its review of Studies Evaluating the Impact of Surface Coatings on the Level of Dislodgeable Arsenic, Chromium and Copper from Chromated Copper Arsenate (CCA)-Treated Wood. Advance notice of the meeting was published in the *Federal Register* on September 1, 2006. A notice announcing revision of the meeting dates was published in the *Federal Register* on November 1, 2006. The review was conducted in an open Panel meeting November 15 – 16, 2006 held in Arlington, Virginia. Dr. Steven G. Heeringa chaired the meeting. Joseph E. Bailey served as the Designated Federal Official.

The FIFRA SAP met to consider and review Studies Evaluating the Impact of Surface Coatings on the Level of Dislodgeable Arsenic, Chromium and Copper from Chromated Copper Arsenate (CCA)-Treated Wood. The studies were conducted by EPA and the CPSC staff. The Agency was seeking input from the SAP on the design and methodology employed in the studies, extrapolation of the results, and areas for future research.

CCA is a preservative that is impregnated under pressure into wood to protect it from decay and insect damage. In October 2001, the EPA requested guidance from the FIFRA SAP about risk mitigation measures, such as the application of surface coatings, for CCA-treated wood (SAP Report No. 2001-12). The 2001 SAP Panel made "recommendations regarding the need for additional studies in this area..." because the "weight-of evidence from available studies indicates that certain coatings can substantially reduce dislodgeable and leachable CCA chemicals." The 2001 Panel also recommended that "EPA inform the public of the ability of certain coatings to substantially reduce leachable and dislodgeable CCA chemicals…"

In response to these recommendations, EPA and CPSC staff (Interagency Agreement # CPSC-I-03-1235) conducted studies evaluating the ability of selected coatings to reduce the amount of dislodgeable chemicals on CCA-treated wood surfaces under natural weather conditions for two years (August 2003 – August, 2005). The data presented are final data from the studies; interim one-year data from the studies were reviewed through a letter peer review process previously. Data submitted for the Panel's consideration included reports on the EPA and CPSC staff studies and public comments submitted.

The agenda for this SAP meeting included an introduction of the issues under consideration provided by Nader Elkassabany, Ph.D. (Antimicrobials Division, OPP). A summary of the coatings study conducted by EPA was presented by Mr. Mark Mason (Air Pollution Prevention and Control Division, National Risk Management Research Laboratory, Office of Research and Development, EPA). An overview of the CPSC staff study was presented by Jacqueline Ferrante, Ph.D. (Directorate for Health Sciences, CPSC). Points of clarification about the EPA study were provided by Leonard Stefanski, Ph.D., of the North Carolina State University and Victor D'Amato, PE, of Arcadis. Points of clarification about the CPSC staff study were provided by David Cobb, M.S., Cheryl Osterhout, Ph.D., Michael Greene, Ph.D., and Treye Thomas, Ph.D., all CPSC staff members.

PUBLIC COMMENTERS

Oral statements on behalf of the Wood Preservative Science Council were presented by:

Doug Splitstone, Splitstone & Associates
Leila Barraj, Exponent, Inc.
Kevin Archer, Chemical Specialties, Inc.

Written statements were provided by:

Jim Hale, Executive Director, Wood Preservative Science Council
Jeff Lloyd, Ph.D., Vice President of Research and Development, Nisus Corporation
Joyce Tsuji (Exponent, Inc.) on behalf of the Wood Preservative Science Council

SUMMARY OF PANEL DISCUSSION AND RECOMMENDATIONS

The EPA and CPSC staff studies demonstrate convincingly that several coatings applied to CCA-treated wood in accordance with the manufacturer's directives reduced the amount of dislodgeable arsenic (DA) by a factor of 10 or more for a period of several months, after which time the level of DA returned to near its original level. However, the studies were limited to only two geographic locations, Maryland and North Carolina, which did not represent the climatic extremes commonly utilized by the coatings and wood industries (Florida for moisture and photodegradation and the Snow Belt for freeze-thaw cyclic stress failures such as cracking). The limited geographic locations limit extrapolations to other sections of the country. Two sources of wood, southern yellow pine in both cases, were used. The coatings tested were a small convenience sample of locally available products and in no sense a random sample of products from all available classes of coatings. None of the coatings were specifically formulated to reduce levels of DA. In consequence, while the studies do show that coatings can reduce DA, the results cannot be generalized to other geographic regions, other sources of wood and all ages of decks in use. The studies were designed to show what would happen if someone purchased a product locally and applied it correctly. They do not show what could be achieved by use of a coating specifically formulated to reduce DA.

Because the coatings were applied according to manufacturers' specifications, surface preparation is confounded with coating product, so it is impossible to determine what role surface preparation played in mitigation. Cleaning could be an effective alternative to coating, but additional research is clearly warranted on this point. It should also be noted that the use of coatings for exposure mitigation carries with it the complexity of dealing with coating failure and the need for removal and re-application. Thus, the value and advisability of the use of coatings for exposure mitigation should be carefully evaluated, taking into consideration the maintenance needs compared with alternative approaches.

The graphical analyses are very clear and supported by the statistical tests. Some issues were identified with the statistical analyses; specifically, the EPA repeated-measures analysis requires an assumption of compound symmetry and both analyses assume that intra-board variation is less than inter-board variation and these assumptions need to be addressed. Also, log transformation will make the analysis more sensitive to small variations at low levels of DA and this could bias the conclusions if the effect of coating on the level of DA is not multiplicative. The Panel did not believe, however, that a more refined analysis would lead to a substantial change in the conclusions.

It is encouraging that the general conclusions of the EPA and CPSC staff studies are in agreement despite some fundamental differences. In particular, the choices of baseline value and normalization method were different and the wipe protocols were very different. The wipe protocols would benefit from further refinement based on the experience of both studies. Particular issues to address include the use of saline versus distilled water to wet the wipe, the effect of picking up splinters from older wood, and the need to measure surface moisture at the time of the wipe and adjust for it in the analysis. Soluble and particulate DAs should be separately quantified. A scanning electron microscope technique using dot-density imaging of each element separately would give a better assessment of the wipe protocol.

Without a measure of the associated risk, the Panel could not say with certainty whether more studies would be worthwhile. The Panel did, however, discuss possible improvements to the design and identified a number of factors that may be important and could be incorporated in future designs. These include the dimension and age of test specimens, the orientation of the growth rings to the surface being tested, and sapwood versus heartwood. The processes of mildew formation and photodegradation are likely to be important and should be considered. The Panel noted that future studies should include at least the two geographic regions, Snow Belt and Southern (typically Florida), used by the coatings and forest products industries in order to make the results more applicable to the nation as a whole. The coatings industry could be asked to formulate coatings specifically intended to reduce DA and these could be tested. Studies such as these with a standardized wipe protocol could be supplemented with simulation models of real-life exposure scenarios.

PANEL DELIBERATIONS AND RESPONSE TO CHARGE

The specific issues addressed by the Panel are keyed to the background documents, references, and the charge questions provided by EPA and the CPSC staff.

Charge Question 1. The Scientific Advisory Panel (SAP) members are asked to identify the scientific merits and limitations of the design of the studies and the analyses of the results. The SAP members are also asked to comment on the quality of the data, including its objectivity and utility.

Panel Response

The response to this question will be divided into three parts. The first addresses the EPA study, the second the CPSC staff study, and the third refers to both studies.

Part 1 - EPA Study

The design used in the EPA study to evaluate the effectiveness of coatings in reducing dislodgeable chromium, copper and arsenic (DCCA) was reasonable. The study design is composed of a treatment structure and a design or randomization structure. The treatment structure is a three-way factorial with factors identified by coating type, wood source, and end grain orientation. The design structure is a split-plot design with repeated measures on the subplot units. Minidecks correspond to the whole plots to which coatings are randomly assigned. Each coating is replicated on three different minidecks. Four of the boards on each minideck correspond to the four combinations of wood source and end grain orientation. Repeated measurements were taken over time after 1, 3, 7, 11, 15, 20, and 24 months. Two baseline measurements were obtained for each board prior to coating and the two measurements were averaged to create a single covariate for each board. The variables analyzed were the logs (to the base 10) of the observed levels of arsenic, chromium, and copper.

The models used to analyze the data are appropriate provided that the repeated measures satisfy compound symmetry. Compound symmetry implies that the variances are the same at all time points and that the correlations between pairs of measures at all time points are equal. In this case, the effect of the covariate is assumed to be the same for all combinations of coating, wood source, grain orientation, and time. It would be helpful if the final study reports addressed the appropriateness of this assumption. It is doubtful that assuming a different covariance structure will change the main conclusions from this study, but the reports should address this issue.

The graphical displays of observed results are useful and informative, especially Figures 3.14 – 3.26. These displays suggest that coatings will reduce amounts of DCCA for several months and then the amounts of DCCA tend to increase over time. The statistical tests performed show that the observed results are statistically significant. Table 3.5 in the report does not agree with the results in Appendix O and this discrepancy needs to be resolved. Table 3.6 should be removed from the final report as the study was not designed to consider such comparisons.

The limitations of the study have been correctly identified in that only two sources of deck wood were used and the experiment was performed in only one location.

Part 2 - CPSC Staff Study

Nine minidecks were constructed. Each minideck contained nine planks. While the planks on the minidecks were sampled at three different frequencies, all planks were sampled at 12 months and 24 months. The statistical analyses presented in the report correspond to the 12 month and 24 month data only, and the Panel's response is focused on the 12 month and 24 month data. Planks used in the study came from new CCA-treated wood boards, and two planks came from each board. In constructing the minidecks, no two planks from the same board were used on the same minideck.

Coatings were randomly assigned to the minidecks. One and only one coating was applied to all boards in each minideck, except for coating 11. Coating 11 was assigned to four planks in its minideck. The variable analyzed is the log of the ratio of the DA at months 12 and 24 divided by the baseline values of the DA.

Exploratory analyses were interesting and useful. Two R_p values were obtained from each of the planks measured according to the prescribed sampling schedule on each minideck (except for coating 11). Plots of the geometric means of the measured R_p values were plotted against time. The plots indicate that coatings tend to reduce levels of DA initially and then the levels of DA increase toward baseline values over two years. It was noted that the geometric mean of the R_p values is equivalent to the exponentiated average of the logs of the R_p values.

It is noted that whereas the EPA recognized the split-plot repeated measures structure of their experimental design, the CPSC staff study does not. One or two panelists believed that this limits generalizations from the CPSC staff study while other panelists did not see this as a serious issue. This affects the appropriateness of the statistical model described in Table A and whether statistically sound generalizations can be made from this study.

Part 3 – Issues common to both studies

Scientific merits of the design(s):

The scientific merits of the designs rest on the answers to the question of whether the designs address the appropriate study objective. Or another way of putting it is “what specific objective is each study design good for?” The study objectives have big implications on the ability of the study results to be generalized. Five potential objectives were identified either from the two reports or the presentations and discussions before the Panel. The Panel recognizes that the studies are designed to assess the potential for individual surface contact with arsenic, chromium and copper and are not designed to address the consequent risk.

Objective 1. To support efforts to inform the public regarding the use and maintenance of existing CCA-treated wood products, such as decks and playground equipment. This objective assumes study objectives will apply to all CCA decks in the U.S. regardless of their current condition. The EPA study and the CPSC staff study are limited in spatial extent and age of

decks and may fall short of providing sufficient information to address this objective. There was little support among the Panel members that the studies addressed Objective 1.

Objective 2. To identify specific surface coatings (or even coating types) that could reduce arsenic availability from CCA-treated wood. Inference space is all potential CCA-treated wood coatings. This objective implies that the study results relate to expectations of what we might see from the whole range of possible surface coatings and or coating types. The EPA and CPSC staff studies identified the different coating types and had multiple representatives from each type. At issue is the number of representatives of each coating type, which was too small to support estimating the range and distribution of effectiveness from all members of each coating type. In addition, the coatings were chosen from a limited regional set with subjective criteria. They were not a random selection from the whole population of products in a particular coating type class. This makes it difficult to extrapolate results to the broader population of coating products and, hence, difficult to see that these studies are adequate for this objective. There was discussion and some disagreement as to whether the studies actually addressed Objective 2.

Objective 3. To evaluate the ability of typical deck coating products to reduce DCCA chemicals on pressure-treated wood. This objective is stated in some of the material that the Agency presented to the Panel. The implied inference space for this objective is limited to the issue of whether DCCA on the wood tested is capable of being reduced by some coatings. The studies are then seen as proof of concept experiments. These studies are clearly adequate to address this objective and do indeed demonstrate clearly that certain coatings can reduce levels of DCCA. Further, they provide information helpful in identifying which factors will affect the effectiveness of certain types of coating in DCCA reduction, and they establish the fact that coatings work initially, but the effectiveness of all of the coatings tested diminished over time. The available information is limited due to the limited number of factors addressed in the studies compared to the many factors that are known to have an effect or are suspected as having an effect on DCCA levels. The following list of factors was compiled by a Panel member.

1. Wipe method: number of passes (1, 2) controlled.
2. Wipe method: wipe length (EPA, CPSC) defined.
3. Wipe method: speed of passes (continuous) not controlled.
4. Wipe method: preparation of wipe before sampling (EPA acid wash/EPA unwashed wipe 2X DI water/CPSC 1X Saline) controlled.
5. Wipe method: sample preparation (EPA/CPSC) controlled.
6. Wipe method: sample extraction (EPA 3 step/CPSC 1 step) controlled.
7. Wipe method: analysis of wipe sample (EPA/CPSC) controlled.
8. Wipe method: amount of shape forming (1/4 sheet/ ½ sheet).
9. Wipe method: degree of cleaning effect – uncontrolled.
10. Wood: source deck (two for EPA, one for CPSC).
11. Wood: bark side up or down (both used in EPA study, up only in CPSC staff study).
12. Wood: blocking to incorporate multiple sample areas on a board.
13. Wood: top face vs. bottom face (only top face used).
14. Wood: grain orientation (not used).
15. Wood: grain spacing (not used).
16. Wood: grain type (edge/flat, not used).

17. Wood: wood season (spring/summer, not used but both present).
18. Wood: wood type (heart/sap, not used but both present).
19. Wood: board preparation (as per coating directions, pre-rinsed/as is).
20. Wood: amount of As, Cr, Cu in wood core (measured, used as covariate?).
21. Wood: age (assumed even aged within source deck).
22. Wood: degree of wear (visual inspection).
23. Coating: product type (paint, stain, sealant, encapsulant - more than 150).
24. Coating: product base (oil, water).
25. Coating: number of coats (1, 2).
26. Coating: pre-application preparation (none, clean/rinse, pressure wash).
27. Coating: application method (brush, roll, spray).
28. Coating: manufacturer's expectation of lifetime (may not have effect).
29. Coating: permeability (not used).
30. Design: handling of controls (positive and negative, matched or group).
31. Design: degree of treatment replication (3 per coating/4 boards per deck).
32. Design: method of randomization.
33. Design: strategy of determination of baseline (blocked/matched spatially).
34. Design: when baseline samples taken.
35. Design: how to do repeated measurements.

Most of the Panel agreed that the studies addressed Objective 3.

Objective 4. To develop, evaluate and demonstrate protocols for measuring DCCA and to begin to understand the protocol's utility and realism. This objective was stated in the documentation provided to the Panel on the wipe studies performed to support the wipe and sample preparation protocols, but could be construed as the objective for the full DCCA studies. This objective suggests that the studies are simply experiments designed to work out the issues surrounding a new data collection protocol in a situation where an established protocol is not available. At issue is the question of whether reasonable measurements can be achieved and the protocol repeated consistently. The EPA and CPSC staff studies provide information sufficient to support this objective. Most of the Panel agreed that the studies addressed Objective 4.

Objective 5. To identify future research needs. This objective underlies most scientific research and relates to the goal of gathering new facts in order to support developing conceptual models of a process or system and identifying the next set of hypotheses to examine. If this were the only valid objective for the studies under discussion, the inference space of the studies would not be an issue. The Panel's view is that the studies only provide information that will be useful to designing the next studies. The EPA and CPSC staff studies support this basic objective by providing useful information on factors affecting DCCA level reduction and failure trends for coating types. Most of the Panel agreed that the studies addressed Objective 5.

Scientific merits of the analyses:

The scientific merits of the analysis rest on the answers to two questions. First, does the analysis methodology (e.g., the statistical models and tests) properly identify and incorporate the actual study characteristics? Second, are the assumptions that underlie the analyses supported by the data?

There was extensive discussion about whether and why a log transformation was necessary in the analysis models. It was pointed out that the log transformation was needed to address both the additivity assumption inherent in the use of linear analysis models and in supporting the assumption underlying the use of formal statistical tests. There was discussion as to whether data were available to estimate intra-board (within board) variability and inter-board (board-to-board) variability in baseline levels of DCCA. The study designs imply that intra-board variability would be much less than inter-board variability, but a check on this assumption was not provided in the reports. This issue is related to the assumption that all boards used from a given deck have had relatively uniform wear.

A linear analysis of the log-transformed data is motivated by the assumption that the effect of each coating is to reduce the level of DA by a multiplicative factor. This effectiveness factor varies from coating to coating, and may diminish over time, but is assumed to be independent of the initial level of DA. Thus, the linear analysis on the log scale gives as much weight to a small absolute reduction from an initially low level as it does to a large reduction from an initially high level. These reductions are not equivalent in terms of their protective effect.

Limitations of the design:

At least one Panel member thought that the studies used insufficient numbers of different products of each coating type to be able to estimate the variability of responses for each coating type, thus limiting the researchers' ability to make inferences to a global population.

Other Panel members felt that the specific wood factor characteristics used as design factors in the studies were not necessarily those that would have been expected to affect the ability of coatings to reduce DCCA. Further, the differences in the designs and conduct of the two studies and the lack of detailed data provided in the CPSC staff study make it difficult to compare the results.

Differences in wipe protocols or justifications for the differences were not explained in the documents. For example, EPA used deionized water and CPSC staff used saline. Why the difference, and would the difference influence what was collected on the wipe sample? An Agency presenter explained that they were concerned about salts on the wood as a result of using saline, but then said that they didn't think that was an issue. No salt assessment was conducted.

The EPA wipe protocol is reported to be based on the CPSC staff protocol. The CPSC staff wipe protocol is not described in detail, but a reference is cited. Unfortunately, the journal is defunct and the reference difficult to obtain. Polyester wipe material has the potential for snagging on the wood. The EPA study report (page 42) refers to 'hold ups' from rough wood; was any of the wipe material lost in 'hold ups'? If so, what is the likelihood that some CCA was also lost? Was this observed? Since the wipes are not pre-weighed, the usual method of assessing wipe loss, via mass loss or no mass change, could not be assessed. One might expect that as the wood ages, more 'hold ups' would occur and that the production of splinters or loss of wipe medium during wiping would increase. The report mentions that wood bits larger than a grain of rice were removed from the wipe samples before analysis. What is the likelihood that CCA on smaller lumps might influence the results? One might expect more lumps to come off as

the wood ages; in other words, the increase seen over time may simply reflect the wood lumps smaller than a grain of rice that were adhering to the wipe sample.

The use of one-year old and seven-year old wood in the EPA study is representative of what might be found in newer structures, but not necessarily the full range of CCA-treated wood that is in residential use. It therefore provides only a preliminary assessment of what the effects might be of treating relatively new wood. It does not address the effectiveness of coatings for older woods.

Descriptive assessment of the boards note that some of the wood suffered from major to severe mildew build-up. One issue is whether the wipes on heavily mildewed wood would actually be contacting wood surface? There are a number of articles suggesting arsenic methylation from mildew causes some of the arsenic to volatilize and, therefore, leaves less to wipe off the surface (Cullen *et al.*, 1984).

Appendix D describes the application protocol for coatings 1 and 8 as "wood is allowed to dry for 2-3 days after the power wash"; coatings 2, 3, 4, 5, 11 “allow to dry;” and coating 12 “allow to dry for 24 hours.” For those coatings in which it states, “allow to dry,” how long was the drying time? If based on professional judgment, what is the rationale/protocol?

The wipe media in the two studies use different amounts of fluid to pre-wet the wipes. Are the differences found in the cross comparison study due to differences in fluid used in the wipe method?

Limitations of the analysis:

The EPA analysis model utilized a log-transformed concentration response using the log-transformed concentration baseline value as a covariate. The CPSC staff analysis model utilized the ratio of log transformed concentration to log transformed baseline as the response. Statisticians on the Panel suggested that the CPSC staff model can be viewed as a restricted form of the EPA model and, as a result, they felt that the CPSC staff analysis was limited by the model used. Panel members who were not statisticians were more comfortable with the CPSC staff analysis. There was concern about the low correlation between the EPA and CPSC staff wipe results. Perhaps the comparison was done over too narrow a range of arsenic concentrations.

The authors of the EPA and CPSC staff reports, as well as the Panel, acknowledged the limitations of the studies. Public commentators challenged the universality of the studies without acknowledging their value. While the studies may not meet standards of universality in their application, they should not be entirely invalidated, but rather the conclusions limited. The range of wood ages is not ideal, nor is the range of climates tested. But if the pattern of effectiveness of the different coatings is consistent across these ages and climates, the results should be reliable, at least qualitatively, for areas that experience similar ranges of temperature and humidity. Also, decks that are in use are likely to suffer some degree of abrasion from foot traffic, whereas the experimental decks were not subjected to foot traffic. While this limits the interpretation and scope of the results, it has no bearing on the objectivity of the studies.

Quality of the data (objectivity and utility):

One Panel member commented on the change in Data Quality Indicator (DQI) goals for precision and accuracy for concentrations <10µg/l, indicated in Section 4.1 (see page 115) of the EPA report. Discussion with EPA staff indicated that this change affected only the lowest level of spiked samples (1 µg/l) and very few actual measurements. In general, the vast majority of observations were 10 times greater than this lowest level and hence this DQI goal change had little impact on overall data quality. This should be clarified in the report.

In general, the Panel felt that the experiments strongly demonstrated that coatings in general can and do reduce DCCA levels. However, the Panel expressed concern about extrapolation of experimental results to untested conditions. The Panel recognized that these studies are the first to test coating of CCA-treated wood directly and that the results clearly indicate the efficacy and limitations of these coatings in reducing DCCA.

Charge Question 2. Please comment on whether the reports have captured the critical findings of the studies objectively and appropriately consistent with the data. Please identify any other conclusions that can be drawn from the data.

Panel Response

Do the reports objectively and consistently capture the critical findings of studies?

There are several ways in which to approach the response to this question. One is in overall perspective, a second is in terms of whether the statements in the Executive Summaries of the two documents objectively and consistently capture the critical findings of the studies, and the third is in terms of whether the statements in the conclusions capture the critical findings of the studies.

The general conclusion that there is a short term reduction in DCCA does capture the general findings for both studies, within the confines of the methods and products used, the type and ages of woods tested, and the region of the country in which the studies were conducted. The EPA report objectively captures the primary finding that there is a significant decrease between background and samples taken one month afterwards, although the differences are not always statistically significant (see page 119). The CPSC staff report also objectively captures the primary finding of a short term reduction in arsenic after application within the confines of new wood sources weathered in the Mid-Atlantic area. Both studies provide many caveats as to whether the findings can be extended to other woods, other coatings, and other environmental conditions.

In so far as evaluating the effects of coating on dislodgeable arsenic from the surface of treated wood, the basis for the conclusions of both studies was clearly presented, including recognizing the limited scope of the study design and the nature of wide variability of the collected data. These and other study limitations are further discussed in the Panel's response to Question 1.

However, from the standpoint that these tests will support EPA and CPSC staff efforts to “inform the public regarding the use and maintenance of existing CCA-treated wood products”,

data collected from these two studies by themselves would appear to have limited application for other scenarios nationwide, for example, type of wood, geographic factors, coating formulation, etc. This is not to say that extrapolation of these data cannot be made useful as a component of exposure modeling.

Some of the statements in the conclusions sections of the reports stretch the data, considering that it is a limited database. The EPA study evaluated two sources of used deck boards, with a limited number of coatings in one region of the United States, without abrasion similar to normal use in service, while the CPSC staff study evaluated new treated boards with a limited number of coatings in one location, without abrasion similar to normal use. Taking results from either of the studies and predicting what will happen in other geographical locations under different climatic conditions and under normal in-service abrasion conditions as a function of age in-service is beyond the scientific merits of the database from both studies.

Some of the statements in the conclusions section tend to be subjective considering that the report contains a database designed to accomplish specific objectives. For example, the conclusion section in the EPA report states that products recommended for application with more than one coat performed significantly better than single coat products, but the study design did not examine this question directly. It would be appropriate to move inference statements such as this, that were not part of the experimental design, to a new section related to future research. Further, the fact that the effects of wood surface pretreatments prior to coating were not considered severely limits the conclusions and predictions that can be drawn from the analyses of the data.

The authors have reached too far in many of their subsidiary conclusions, such as the relative performance between coating types. While the statistics may be valid, in practice, the conclusions are at best misleading. A competent formulator of coatings, for example, can readily alter any of the coatings in the various classes to achieve very different results from those reported. The coatings chosen were based on local availability, not on their claimed ability to perform as an agent to block DCCA. If the experimental base is inadequate, one cannot competently comment on the relative performance of the various classes of coatings.

The authors of both reports are encouraged instead to create a new section of their report wherein they can legitimately comment that the data are suggestive of further differentiation of performance but do not by any means prove it. They should not attempt to even speculate as to the relative performance of given classes of coatings, but rather only suggest that further work designed to test for this is clearly justified.

The EPA report and its supporting documentation is fairly thorough and adequately captures the findings and the limitations of the study (ARCADIS document). The writers appear to be aware of the challenges in the study design, and the impact of the study design on the data that was obtained. The CPSC staff report does not provide the same level of detail regarding methodology and sample results. This makes it difficult to evaluate critically whether the report objectively and consistently captures critical findings.

There is a lack of consistency between the conclusions and the Executive Summary in the EPA report. For example, in the conclusions there is a discussion of effects of abrasion versus cleaning, which is not fully substantiated by the study results as presented.

A number of areas in the EPA report contain statements lacking statistical analysis to support them, or the statistical analysis does not support the statement. One example (see page 58) about cross-contamination states, "there appears to be more DA from the cross-contaminated controls versus the blank minideck controls." No statistical analysis follows and Table A-7 in Appendix A does not provide much insight into the issue.

No distinction is made in DCCA between water-soluble and insoluble particulate forms. This is unfortunate, because such information would have spoken to both the extent of hazard actually encountered, and to the best manner in which it could be addressed.

What other conclusions might be drawn from the data?

The Panel believed that in order to draw other conclusions from the data, further data analysis would need to be done. For example, it would be interesting to see if more analysis can be made on the effects of weather and DA. This interest stemmed from the segment of plateau during December-April in some scenarios, more evident in the EPA study than the CPSC staff study. The analysis with weather data also may lead further into the interaction of multiple weather variants (radiation, precipitation and temperature) which in turn may inform what is needed for modeling the behavior of coatings on DA for other weather types and geographic locations in the U.S.

With a little effort it might be possible to compare the results of the two studies. To the extent possible, whether it is about weather or other factors in the study design, the similarities and differences with respect to the outcome on DA can be a valuable first step in looking to see if these and other existing data can be used to address different exposure scenarios.

These are the first studies attempting to quantify reductions in DCCA using selected coatings on CCA-treated wood. Given the large volume of CCA-treated wood currently in use, and that there are over 100 different coatings available for use in retarding moisture adsorption in wood, the results of these two studies are a respectable start for this research focus. However, the current database needs to be significantly expanded before the methodologies will be accepted by the coating industry, wood treaters, or consumer groups. All standard tests used by the wood industry (ASTM, AWPA, etc.) require many studies before they are accepted.

The data suggest that the effect of washing/preparation may be as significant as some coatings. However, it would be desirable to think about procedures that will not cause downstream problems such as those that could occur when paints and other coatings fail and potentially create bigger problems.

The Panel was concerned that artifacts may be produced by the wipe method. This might be resolved by using a scanning electron microscope to create maps of individual elements. Instead of scanning for all elements at a given spot, the EDAX analysis (energy-dispersive analysis of X-rays) can be set to a single element (energy level) and a dot-density image created that represents the distribution of the element in question over the image surface. At low magnifications, this technique can be used to unequivocally answer the question of whether the wiping technique actually removes the element in question, or merely moves it around on the surface of the panel being tested.

While not specifically tested or proved, the data in the report suggest that the preparation steps might prove to be of significant value in mitigation, separate from any coating steps. They are significant because non-coating solutions could be developed which are simpler and less expensive and would not suffer the drawbacks of re-coating after relatively short times. This issue is discussed in the response to later questions.

Charge Question 3. Please comment on whether the statistical methods employed by EPA and CPSC staff represent a scientifically justifiable and robust approach to evaluation of the data. Have the statistical analyses, including the analyses of variance, been presented in an appropriate, useful, clear and transparent manner?

Panel Response

The Panel's responses to Questions 1 and 2, which include extensive discussions of the statistical analysis and whether the results can be extrapolated to broader conditions, have largely addressed Charge Question 3.

The graphical analyses, supported by mixed model analysis of variance, indicate that some cleaning and coating processes can reduce DA by a factor of 10 or more for a few months.

Because the decks were not subject to normal use, which is likely to abrade and degrade the coatings faster than weathering alone, the indicated duration of DA reduction can only be taken as an upper bound for the coatings and preparation processes studied. On the other hand, the selection of coatings and surface preparation methods was limited and it is possible that longer durations could be achieved.

Perhaps this is already enough information for deciding whether or not to pursue the idea of coating existing decks and play structures to reduce exposure to arsenic. However, this Panel is only looking at mitigation of exposure. Without an understanding of the associated risk, one cannot determine whether or not the observed reduction in DA is enough to mitigate the risk to children.

Both the EPA and the CPSC staff studies are limited by the restriction to yellow southern pine, non-random choice of location, and limited number of sources of the wood. The CPSC staff study, in particular, is limited by the confounding of coating type with mini-deck. This restricts extrapolation of the results. The general agreement between the two studies gives some assurance that the results will be reproducible in a better-designed study.

The statisticians on the Panel agreed that an improved statistical analysis would not change the conclusions or make the result more general; however, it would be worth including a random effect for board and plank within board in the EPA study. Including a sapwood/heartwood factor may also be worthwhile. It would be worth repeating the analysis in original rather than logarithmic units to see if that changes any of the conclusions.

The documentation for both studies is not easy to read, but is thorough and, for the most part, clearly states the limitations of the studies. A discussion of the compound symmetry assumption is needed (see Panel's response to Question 1). A more forthright discussion of

sources of variability in the analysis models would be useful for future study design, particularly in the calculation of sample sizes required to achieve the desired power in the statistical tests.

Charge Question 4. Certain specific issues, such as the impact of abrasion and coating reapplication, were not examined in these studies. Please comment on how these data gaps have been sufficiently accounted for in the discussion of the results of these studies.

Panel Response

The objective of these studies was to evaluate the impact of surface coatings on the level of DCCA from CCA-treated wood. Other specific issues such as the impact of abrasion and coating reapplication were not examined and, therefore, are not adequately accounted for in these studies. This question addresses essentially an extrapolation of the study results to factors not tested in the current experiments. The statistical models used to analyze the study data can only be used to do a very limited amount of extrapolation. The larger issue is what other information can be used to perform this extrapolation? Does the extrapolation have to be quantitative or qualitative? There was discussion among the Panel about how the data from these studies, along with qualitative information from the over 50 years of research on coating of CCA wood products, should allow a qualitative assessment on the impact of abrasion and coating reapplication.

The original question was whether surface coatings could reduce levels of DA. It now appears that the preparation of the wood may be as important as the coatings themselves in reducing DA. The studies have confounded the coating with the preparation and are not able to answer this question. If the preparation removes the surface arsenic, then the process may be hazardous to the applicator and may increase the toxicity of the soil under the structure. This would require a study of its own.

It is important to note that in the EPA study the effect of abrasion due to repeated wiping of the sampling areas seems to indicate that this type of abrasion may have had the effect of temporarily cleaning up the sampling areas, although there was no significant influence on the DCCA levels by the number of previous wipes (NOPW factor), which was described as a surrogate for the effect of abrasion at each sampling event.

The authors of the EPA study state that they did not examine the impact of abrasion on the measurable DCCA. Abrasion has been identified as an important variable in coating performance. The EPA study recommends additional testing to examine the effects of abrasion including simulating foot-traffic on the deck surfaces. However, this particular issue is very complex because the extent of UV degradation of the treated wood surface and coated wood surface, surface preparation prior to application of the coating, moisture content of the wood surface, history of past and current surface and coating treatments, and wood characteristics are some of the many confounding variables related to the effects of abrasion.

The study design also did not control the time period for each wipe stroke because the time for the polyester wipe material to traverse the test section of the different boards was influenced by the board roughness. The authors are aware that these issues may have influenced the differences in DA observed between the two sources of deck material. The experimental design and sampling method did not differentiate between dislodged treated wood particles and

soluble DCCA. The study design did not address the impact of particle collection on coating performance.

The authors of the EPA study state in the Executive Summary that the results of the study suggest that the coatings need to be periodically reapplied to maintain DA mitigation compared to an uncoated treated board. They also state that it appears a one-year recoat schedule would be appropriate for the conditions tested in the study. Different geographic locations, different coatings, and a significant abrasion component to the experimental design may change the time frame from the one-year recoat recommendation. The CPSC staff report recommends that applying oil- or water-based penetrating stains to CCA-treated wood structures every one to two years may reduce arsenic availability. They also state that their experimental design did not include abrasion to simulate in-service use. The frequency of reapplication is product dependent and is influenced by weather conditions, geographic location, the condition of the wood, and use patterns of the structure.

Coatings were applied based on manufacturers' recommendations. These recommendations varied with regard to surface preparation steps prior to application of the coatings and number of coats applied. The study design did not examine the question directly as to the effectiveness of multiple coats versus single coats or reapplication of coatings.

Additional studies would be needed to specifically evaluate the impact of coating reapplication on the dislodgement of CCA components. The reapplication of coatings to a treated wood surface is a complex issue that is influenced by a considerable number of parameters. In addition, coating formulations are constantly being reformulated in an effort to improve their effectiveness, in particular, moisture excluding effectiveness. Neither of these studies attempted to examine the moisture excluding effectiveness of the coatings. Moisture is related to abrasion. Surface checking in wood surfaces exposed to changes in the moisture content of the wood surface is a result of adsorption and desorption of the moisture from the wood surface. Abrasion, surface checking, and UV degradation will directly influence the formation of dislodged treated wood particles. Adsorption and desorption of moisture from the surface of the wood, along with abrasion, surface checking, and UV degradation, will influence the amount of soluble DCCA.

In the coatings industry, substrate preparation is crucial to the subsequent performance of all coatings systems. Such preparation is not just helpful, advisable, or useful; it is absolutely essential. The significance of this is:

(1) Substrate preparation is the major determinant of the lifetime of subsequently-applied coatings. Lifetimes can vary by factors of 2-5, simply due to differing degrees of preparation. This plays a major role in the time interval for performance before recoating is needed.

(2) Experience suggests that it is likely that a well-designed future study would show that a proper preparation step is at least as significant as the use of coatings in achieving mitigation of DCCA, and might even obviate the need for coatings to achieve the desired reduction in DCCA.

(3) Some of the substrate preparations involved the use of oxidative cleaners. This is ill-advised for CCA-treated woods, since it will both oxidize and solubilize the treatment chemicals, which will increase their bioavailability. It will also alter their toxicity: for example the chrome can be oxidized by such cleaners to Cr^{6+}, which is carcinogenic.

(4) While manufacturers' recommendations for substrate preparation were followed in the present studies, the consequence is that this became yet another uncontrolled variable, since manufacturers don't have common recommendations. It should also be remembered that such label information is a negotiated settlement among the various constituents in a given company, including legal, and does not necessarily represent the best scientific advice of their R&D departments.

(5) It is possible that there are simple chemical pretreatments, e.g., precipitants, that could adequately reduce future DCCA, so as to obviate the need for coatings. Such treatments could be simpler to use, cheaper, and would eliminate the need to deal with the inevitability of future failures of the coatings system, which will require further preparation and recoating. Such treatments could be applied as part of the substrate preparation step.

The issue of re-application of coatings after the initial coating has failed is not covered in the study. While that is understandable, given the scope of the study, some comment is needed in the report that the use of coatings must be considered in the context of both their initial properties, plus the steps (and frequency) needed to properly maintain the coatings and their desired effects.

The issue of abrasion is relevant to the bare, uncoated pressure treated wood, as well as any coating that may be subsequently applied to the pressure-treated wood.

The impact of abrasion and coating reapplication issues were not examined in either study, but have been identified in both studies as being important issues. These studies have highlighted the need to conduct additional studies specifically designed to evaluate the dislodgement of CCA components resulting from foot-traffic abrasion on in-service decks. In addition, because of the complexity of the interactions of a number of variables with both of these issues, it is difficult to account for these data gaps sufficiently in the discussion of the results and subsequent recommendations. More detailed studies are needed to address these issues.

Charge Question 5. The studies were performed under limited study conditions (one climatic region, i.e., the mid-Atlantic U.S., the structures were not subjected to normal use or wear, etc.) with a limited set of products. Please comment on whether it is appropriate to extrapolate these results to other conditions.

Panel Response

Performance characteristics of any wood coating should be determined by its desired end use. In this instance, performance characteristics of coating products for reducing levels of DCCA on wood structures outdoors is desired. Thus, if claims are to be made that a particular coating product reduces the levels of DCCA from CCA-treated wood, then it must be subjected

to more extensive evaluation under a wider range of climatic conditions. In the current studies, a limited set of coating products were evaluated in only two contiguous climatic regions, the lower Mid-Atlantic and upper Southeast regions (Maryland and North Carolina). It is desirable that these studies be conducted in all the different climatic regions in the continental United States, namely: (i) the Northwestern, (ii) the High Plains,(iii) the Midwest/Ohio Valley, (iv) the upper New England/Mid-Atlantic, (v) the lower Southeast, (vi) the Southern and (vii) the Southwestern climatic regions.

The primary mode of failure of coatings over wood is that of cracking (initiation) followed by flaking and peeling (propagation). Traffic abrasion accelerates the removal of the flaking/peeling coating, but does not materially influence the initiation. The coatings and forest products industry routinely use two locations: northern Snow Belt and southern (typically Florida) region. The former maximizes cyclic stresses that accelerate cracking, while the latter maximizes photochemical degradation and biological fouling. The reports state that coatings may be useful for mitigation for one to two years; however, the time interval of usefulness could be reduced by a factor of two to five if the same studies were conducted in the Snow Belt. Thus, extrapolating the results from these two studies to other climatic regions may be premature.

It is also important to note that in these studies the wood coatings were evaluated for a performance characteristic for which they were not originally designed. Therefore, in addition to climatic conditions, the effect of the wood substrate on their performance characteristics for this "new" end-use warrants further investigation. For example in addition to southern yellow pine, other wood species such as hemlock-fir, Douglas-fir, spruce-pine fir, red pine, ponderosa pine and radiata pine should be considered for evaluation in future studies.

Evaluation of the effect of normal use, and wear and tear on the performance characteristics of coatings in mitigating DCCA levels is complex and difficult and cannot be completed within the limited timeframes as was the case with the current studies. It will require a separate study design and protocol. Elements of such a study design and protocol may include new and aged decks built from different wood species. In addition, the use patterns of decks selected for the study would have to be meticulously monitored both before and during the conduct of the study for a period of no less than two years or until failure.

The simple conclusion, that some coatings make a difference, is clear enough. Before the EPA or CPSC staff conduct a more definitive study, the coatings industry should be invited to develop products with specific characteristics intended to reduce DCCA levels on CCA-treated wood. The new study should be designed to test whether these new products meet specifications.

We are still far from being able to make a recommendation to the consumer. The choice might be to recoat every two years for the life of the deck, or replace the deck and dispose of the CCA-treated wood. We aren't even sure if the expected reduction in DCCA levels from coating alone is enough to affect potential health risks to children. These studies did not address potential health risk to children and the Panel was not asked to determine if the reduction in DCCA levels reduced such risk.

Charge Question 6. Please comment on whether the methodology is suitable for use by others (e.g., the coating industry, wood treaters, or consumer groups) for evaluating and developing

new products. Are there elements of the protocol that you recommend be modified or explored (e.g., the moisture content of the wipe material, wipe contact time on the wood surface, etc.)?

Panel Response

These are the first studies attempting to quantify reductions in DCCA using selected coatings on CCA-treated wood. Given the large volume of CCA-treated wood currently in use and the fact that there are over 100 different coatings available for use in retarding moisture adsorption and absorption in wood, the results of these two studies are a respectable start for this research focus. However, the current database needs to be significantly expanded before the methodologies will be accepted by the coating industry, wood treaters, or consumer groups. All standard tests used by the wood industry (ASTM, AWPA, etc.) required many studies before being accepted.

The Panel discussed the utility of the experimental protocol and/or modifications of this protocol and suggested that at an appropriate point, a challenge be issued to the coatings and wood treatment industries to develop products designed to reduce DCCA to levels that may be determined to be appropriate.

The wipe testing device and protocol represent an excellent starting point for sampling a surface for removables. As such, it should be of interest to others, including the coatings industry, wood treaters, and consumer groups. However, the test will need further development before it reaches the level of approved standard testing procedure. Examples of issues that should be considered in future enhancement of the wipe methodology include the following:

1. Concern was expressed about the low correlation in the EPA-CPSC staff wipe calibration studies. The scatter plots are not given. Were the correlations computed on a log or linear scale? Was the range of concentrations wide enough? Did it cover the whole practical range of concentrations?
2. Procedures for the wipe test are different in the two studies. The procedures for analyzing and obtaining baseline uncoated results for comparison to the results for the coated specimens need to be evaluated and, if needed, modified for future studies.
3. Since moisture is critical to the soluble portion of the DCCA, the surface moisture content of the wood substrate at the time of sampling needs to be part of the data collection and analyses.
4. The wiping protocol results in splinters being picked up from older pressure-treated wood and represents a problem in data analysis by biasing the results from older wood sources. The protocol should be adjusted to include the removal of all splinters before conducting analyses, or alternately, one could analyze splinters separately from non-splinter wipings to determine the magnitude of this potential problem.
5. Soluble and particulate DCCA need to be separately quantified.
6. The sampling method and sampling apparatus developed by CPSC staff needs to be standardized:
    a. size of the sampling area
    b. the number of sampling strokes
    c. the travel time per stroke of the sampling disk

d. type of sampling cloth, size, and its moisture content
e. extraction methodology of the CCA chemicals from the sampling cloth

The goal of the wipe methodology is to determine material present on the surface of pressure treated woods, and to estimate from that what a child might pick up. The polyester material and method used in this study is well correlated ($r = 0.86$) with hand collection when measured with a rinse-wipe-rinse technique (Thomas *et al.*, 2004). However, the dry wipe method captured approximately 3-4 times as much as did a hand when both are rubbed a comparable number of times over the surface. Additionally, a wet wipe collects about twice as much as a dry wipe. In spite of these differences, the correlations between cloth and human hand wiping remain essentially constant and high.

In one of the CPSC staff experiments, the amount collected in a series of 4 consecutive wipes was measured. The quantity collected declined from about 500 µg (wet) and 200 µg (dry) on the first pass to about 150 µg (wet) and 0 µg (dry) on the 4th pass. In the CPSC staff field study, the differences for some experiments were as great as 10 times depending on the surface. The saline-wetted polyester surrogate has effectively a lower detection limit than that of the dry polyester surrogate (Levenson *et al.*, 2004). In other words, for the same hand-wipe amount, the saline wetted polyester surrogate will pick up more arsenic than the dry polyester surrogate, resulting in a greater detection ability for the saline-wetted polyester surrogate (Levinson *et al.*, 2004). From a risk point of view, this wipe method appears to be conservative because it captures more than might be expected from a hand wipe, and is, therefore, desirable, if one can have confidence that it reflects what will adhere to a child's hands, food, or objects that may be mouthed. One could then simply calculate transfer coefficients.

Data reduction and analysis:

Reduction of experimental measurements of DCCA levels for statistical analysis should be standardized. For example, in the CPSC staff study the experimental outcome was reduced to the amount of DCCA measured at a specific time point relative to the baseline amount, whereas the EPA study compared the amount of DCCA measured at a specific time point from coated specimens to the amount of DCCA measured at a specific time point from control uncoated specimens. Although both approaches led to the same conclusions, this element of the protocol does warrant standardization.

Normalization of data:

While direct normalization (CPSC staff approach) and ANOVA with covariates (EPA approach) produces the same statistical results, experience in the coatings industry has shown that direct normalization does a much better job of filtering out experimental noise and differentiating among coatings types in exposure experiments.

Charge Question 7. Please comment on whether these studies are of sufficient quality and breadth to be used to assist in developing conclusions about the ability of certain coatings to substantially reduce dislodgeable CCA chemicals. Have the agencies identified the most important information and findings? Are there other findings/conclusions that could be made from these studies?

Panel Response

The EPA and CPSC staff studies investigated the impact of a set of coating products on southern yellow pine specimens that are either new (never been in service) or aged (one and seven year old decks). In general, the studies were well presented in the reports for review. Both studies demonstrated a fairly consistent pattern of initial DA reduction when coatings were applied according to the manufacturer's recommendations that varied for each product (e.g., pre-coating treatment, number of coats). The Panel recognized that while one might argue as to whether all of them were appropriate as agents to reduce the DA, they could reflect what people might actually do.

Although both studies are of sufficient quality for the observations on certain aspects of DA reduction, limitations of the breadth of these studies do not allow for developing strong and unassailable conclusions about the pattern for the types of coatings to reduce DCCA from treated wood surfaces. Under the experimental conditions, the longevity of the effects of DA reduction varied within each selected coating and between coating products. It is also uncertain as to how these data can be used in estimating human exposures since some key factors representing the real-life situations were not a part of the testing design (e.g., abrasion, woods other than southern yellow pine, climatic effects of different geographic locations). There may also be regional differences in the formulation of coating products designed to accommodate climatic conditions and types of woods that are available.

These studies also did not allow a clear conclusion as to whether coatings are the best for DA reduction, or most economical or most desirable approach. Nor can the studies prove which types of coatings are best or most desirable. Just as the study is suggestive that coatings likely differ in their effectiveness, the evidence from these two studies suggests that the pretreatment steps can be highly significant and useful in mitigating DCCA. The Panel also contemplated the needed context to defining whether coatings substantially reduce DCCA. It was understood that the Agency is proactive in carrying out these two studies in preparation for when and if mitigation may be deemed necessary. A better context for understanding the significance of DCCA reduction as seen in these two studies can be obtained after the Agency completes its risk assessment and determines the target exposure level for public health protection.

The two groups of investigators are to be commended for setting the benchmark for new study protocols and future data collection and evaluation on DCCA reduction. These studies provided the first solid scientific foundation for a more thorough and rigorous investigation of the effect of coatings on release of CCA chemicals from CCA-treated wood used in outdoor structures such as decks and children's play structures. These include informing an understanding of the complexity of testing coating products for an end-use purpose for which they were not originally designed and highlighted and delineated those factors that need to be incorporated into standardized testing protocols designed to evaluate the efficacy of coating products for reducing DCCA levels in CCA-treated wood surfaces.

From the standpoint of collecting data to inform the mitigation of children's exposure to arsenic from CCA-treated wood, future data collection should be guided by how it can be applied to modeling the real life exposure scenarios. For example, one of the impressive findings in these studies is the inherent variability in the type of data such as changes in DA by coating. Properly characterized, they can be effectively used in probabilistic exposure models. Another

area in which data may be used is to determine how to provide linkage such that the current wipe sampling method can be adapted to reflect the real-life exposure scenarios for hand-to-mouth activities of young children. Understandably, all of these considerations are predicated by knowing the target level of acceptable exposure. Knowing the target level would help inform the extent to which the reduction of DA is deemed sufficient, and would also inform the level of detection limit in the chemical analysis.

Panel Suggestions for Future Research Efforts

The Panel made a number of suggestions for future directions for data collection. One area is to more thoroughly utilize the information that is currently available, especially since these two reports did not particularly mention how extensively the Agency looked into the existing knowledge base related to the movement of CCA in woods and coating. The Agency is encouraged to make use of current information to enhance its understanding for the ultimate goal of finding viable ways to reduce DCCA. The Agency is also encouraged to collaborate with bodies of other expert panels who are familiar with coatings and photodegradation responses, another important component in the performance outcome of coatings. The complexity of the issue of reducing DCCA through coating would argue strongly for the development of an overall conceptual model that provides a context for current and future studies. What does the literature have to say about various processes involved in affecting DCCA? What are the physical processes with which we are dealing? What do we know about weathering of wood; of CCA treated wood; of erosion of wood from the deck surface; of abrasion processes; of the composition of coatings; of the relationship of substrate and coating composition; of the moisture exclusion aspects of the coating; and of delamination of the coating as a function of climate?

Additional Considerations for Future Experimental Design Needs:

1. Consider developing and evaluating results from different climatic conditions and geographic regions that may place more or less stress on the coatings
2. Consider age-in-service and effects of abrasion.
3. Coating formulations are important to understanding the relative performance of different classes.
4. Coating products should be tested on substrate/s for which it will be used.
5. Substrate issues should be standardized: e.g, dimensions and age of test specimens; the surfaces of test specimens, including orientation of the growth rings to the surface to be tested; density; and sapwood versus heartwood.
6. It will be difficult to have more than one treatment on the same mini-deck if they require different preparations, unless the planks were individually treated and coated prior to assembling the mini-decks.
7. Consider using scanning electron microscopy techniques for remote assessment and low level spatial analysis using dot density imaging of each element separately to better assess the wiping technique. This could help determine the adequacy of removal of the items under study vs. merely moving them around.
8. Soluble and particulate DCCA need to be separately quantified.

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