I. Purpose of October, 2001, Scientific Advisory Panel (SAP) Meeting

The United States Environmental Protection Agency's (USEPA's) Office of Pesticide Programs (OPP) strategy for exposure and risk assessments for Chromated Copper Arsenate (CCA) and related end uses of CCA-treated wood products is presented below. This overall plan includes a variety of human and environmental exposure and risk assessments which cover uses of CCA products and uses of CCA-treated wood products.

However, for the October SAP meeting the Agency is presenting only those hazards (toxicology) and exposure data and assumptions OPP plans to utilize in the final risk assessment for children playing on/around CCA-treated playground structures. Specifically, the Agency is asking the Panel to:

1. Assess the scientific soundness and uncertainties associated with the exposure scenarios (e.g., exposure assumptions, calculations, routes-of-exposure, child activity patterns) and hazard endpoints that the Agency intends to use in its CCA-risk characterization for children; and

2. Provide recommendations concerning additional data needed to reduce the uncertainties of this risk characterization.

Note that OPP will not be presenting to the SAP the Agency's final risk assessment for children playing on/around CCA-treated playground structures.

Additionally, note that the Agency has moved the children's playground risk assessment ahead of other planned exposure and risk assessments. We have done so because OPP is aware of increased concerns raised by the general public and state/federal regulatory agencies regarding the safety of CCA-treated wood for playground applications, since children may be potentially exposed to dislodgeable arsenic and chromium residues present on the surfaces of CCA-treated wood structures and in soil matrices under/adjacent to such structures. In preparation for this children's risk assessment, OPP is now evaluating: (1) current sources of data available for estimating arsenic and chromium residues from wood/soil media[1]; (2) exposure assumptions and equations used to develop child exposure scenarios and calculate dose estimates; (3) available hazards (toxicology) data for selecting arsenic and chromium toxicological endpoints[2]; and (4) critical data gaps/uncertainties associated with the eventual risk assessment. Much of this

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[1] At this time the Agency is focusing on the risks associated with exposures to arsenic and chromium. Copper is not being considered because of its minimal toxicity to humans. However, copper will be considered in the environmental risk assessment since the available data indicate that copper is the most toxic of the three CCA components to aquatic organisms.

[2] Note that OPP plans to utilize those cancer hazards data/endpoints that the Office of Water (OW) is finalizing. Therefore, these data will not be debated at the SAP meeting.

information will be presented to the Panel in October, 2001.

II. General Background Information

As part of the reregistration process for pesticide products, the Agency is evaluating the potential human and environmental risks of three Heavy Duty Wood Preservatives (HDWPs): pentachlorophenol (PCP), creosote, and CCA. This effort is part of a North American Free Trade Agreement (NAFTA) work project which involves the coordinated efforts of USEPA, Canada, Mexico, and California.

Presently, OPP, working with its NAFTA partners, is evaluating CCA pesticide products which are mixtures of water-soluble chemicals containing metal oxides of chromium as chromic acid (CrO_3), copper as cupric oxide (CuO), and arsenic as arsenic pentoxide (As_2O_5). These products are used as wood preservatives for vacuum-pressure treatment of dimensional lumber which is marketed to commercial and general consumers via lumberyards, hardware stores, and other retailers. CCA-treated wood dominates the residential consumer market for use in landscape timbers, decks, fences, and fabricated outdoor structures (e.g., gazebos, picnic tables, and playground equipment).[3]

III. OPP's Overall Exposure and Risk Assessment Strategy For CCA

Relative to reevaluation of the HDWPs, OPP/NAFTA partners are presently involved in the reevaluation of all registered uses of CCA. This includes evaluation of human exposures and risks associated with occupational and residential scenarios as well as environmental exposures and risks associated with "wood in-use" scenarios (e.g., residential decks, marine pilings). Considering this, Agency/NAFTA partners intend to release a preliminary risk assessment, for public review, in early 2002.

IV. Use Profile of CCA

CCA preservatives protect wood from deterioration from a variety of insects, fungi and rot organisms. There are currently 32 CCA-containing wood preservative products registered with the EPA. CCA can be applied to wood via pressure treatment, brush, spray, low-pressure injection, soak, or bandage treatment, but the predominant use is for pressure treating lumber intended for outdoor use in constructing a variety of residential landscape and building structures, as well as home, school, and community playground equipment. CCA-treated wood, predominantly of Southern yellow pine, represents the majority of pressure-treated dimensional lumber marketed to the general consumer via lumberyards/hardware stores and other retailers. In

[3] Note: As reference, PCP and creosote typically are not used in residential or homeowner settings, but instead are used in industrial or commercial situations. PCP is primarily used to treat utility poles, and creosote is primarily used to treat railroad ties.

some cases, CCA-treated lumber is recycled into wood chips which are stained, then sold to consumers as landscape mulch and could possibly end up in playground sites as buffering materials. Major commercial installations include utility poles, highway railings, roadway posts/barriers, bridges, bulkheads, and pilings. Industry cites advantages of CCA-treated wood over other pressure-treated wood, including superior durability, low-odor, and dry "non-oily" surfaces which can be painted or sealed.

There are three formulations of CCA, each containing varying ratios of arsenic pentoxide, chromic acid, and cupric oxide. CCA treatment solutions are typically classified by the American Wood-Preservers' Association (AWPA) as either type A, B, or C, with CCA type C (CCA-C) being the formulation most commonly used. CCA-Type A contains 14.7 % - 19.7 % arsenic pentoxide (As_2O_5), 59.4 % - 69.3 % chromic acid (CrO_3), and 16.0 % - 20.9 % cupric oxide (CuO).[4] CCA-Type B contains 42.0 % - 48.0 % arsenic pentoxide (As_2O_5), 33.0 % - 38.0 % chromic acid (CrO_3), and 18.0 % - 22.0 % cupric oxide (CuO)[6] (Lebow, Stan, 1996). CCA-Type C is composed of 34.0 % arsenic pentoxide (As_2O_5), 47.5 % chromic acid (CrO_3), and 18.5 % cupric oxide (CuO).

After pressure treatment and fixation, arsenic and chromium can be retained in the wood from 0.25 to 2.50 pounds per cubic foot (pcf), based on the retention of CCA-C in wood following AWPA treatment standards. Typical retention levels achieved depend on the intended applications of the treated lumber. Lower retention values are required for plywood, lumber and timbers used for above-ground applications (0.25 pcf), and for ground or freshwater contact uses (0.40 pcf). Higher retention levels are required for load bearing wood components such as pilings, structural poles, and columns. The highest levels are required for wood foundations and saltwater applications (up to 2.50 pcf). The majority of lumber used in residential and playground settings wood is 0.40pcf treated wood.

V. Hazards (Toxicology) Data - An Overview

For the human hazard assessment the Agency recognizes that inorganic arsenic and inorganic chromium are the compounds of toxicological concern with respect to exposure to CCA-treated wood. Therefore, attached background documents characterize the hazards of arsenic and chromium, but do not address copper. As noted above, copper is not being considered because of its minimal toxicity to humans.

A. Arsenic

Arsenic is a naturally occurring element present in soil, water, and food. In the environment, arsenic exists in many different forms. In water, for example, arsenic exists primarily as the inorganic forms As +3 (arsenite) and As +5 (arsenate), while in food, arsenic exists

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[4] Expressed as minimum and maximum percentages as specified by the American Wood-Preservers' Association (AWPA) standards.

primarily in organic forms (seafood, for example, contains arsenic as arsenobetaine, a form which is absorbed but rapidly excreted unchanged). Human activities such as residual arsenic from former pesticidal use, smelter emissions, and the CCA in the pressure-treatment of wood for construction of decks, fences, playgrounds, and other structural uses also result in the release of arsenic into the environment.

1. Arsenic: Non-Cancer Hazards

For inorganic arsenic in most cases, human data (in the form of epidemiology studies and case reports) provide the basis for the hazard identification, as most laboratory animal models show that animals appear to be substantially less susceptible to arsenic toxicity than humans. OPP proposes to use available epidemiology studies and case reports in the development of short- and intermediate-term non-cancer endpoints. These endpoints will be used with the short- and intermediate-term oral (incidental ingestion) and dermal exposure assessments to develop a final children's risk assessment for playground equipment. Attached background documents provide the bases for determining these endpoints.

2. Arsenic: Carcinogenicity

The National Research Council has recently published an update to the 1999 Arsenic in Drinking Water Report, in which the NRC independently reviewed studies of the health effects of arsenic published since the 1999 NRC report. This update includes discussion of the risk models used to characterize carcinogenic risk from arsenic exposure in drinking water. OPP considers this updated information relevant to the characterization of carcinogenic risk from arsenic exposure in CCA-treated wood, as both involve exposure to inorganic arsenic. Thus, OPP plans to work closely with the Office of Water in developing the most scientifically sound approach to carcinogenic risk from exposure to inorganic arsenic, including carcinogenic risk to children.

B. Chromium

Chromium is a naturally occurring element found in animals, plants, rocks, soil, and volcanic dust and gases. In the trivalent (+3) state, chromium compounds are stable and occur in nature in this state in ores such as ferrochromite. Chromium (VI) is second-most stable relative to the (+3) form, but rarely occurs naturally and is usually produced from anthropogenic sources (ATSDR, 2000b). The general population is exposed to chromium by inhalation of ambient air, ingestion of food, and drinking of water. Dermal contact with chromium can also occur from skin contact with products containing chromium or from soils containing chromium.

In humans and animals, chromium (III) is an essential nutrient that plays a role in glucose, fat, and protein metabolism. The biologically active form of chromium exists as a complex of chromium (III), nicotinic acid, and possibly the amino acids glycine, cysteine, and glutamic acid to form glucose tolerance factor. GTF is believed to function by facilitating the interaction of insulin with its cellular receptor sites, although the exact mechanism is not known. The National Research Council recommends a dietary intake of 50-200 micrograms per day for chromium III.

1. Chromium: Non-Cancer Hazards

For chromium, hazard data show clearly that Cr (VI) demonstrates more significant toxicity than Cr (III). However, there is little data delineating the valence state of chromium in compounds that leach from in-service treated wood (Lebow, 1996), but interconversion of Cr (VI) and Cr (III) in the environment is observed (Cohen et al., 1999), and at least one study has reported measurable levels of hexavalent chromium in soils (Lebow, 1996). In the absence of clear evidence, OPP is proposing to utilize the toxicity database for the more toxic Cr (VI) in its non-cancer hazard assessment and endpoint selection process for chromium. Chosen short- and intermediate-endpoints will be used with the short- and intermediate-term oral (incidental ingestion) and dermal exposure assessments to develop a final children's risk assessment for playground equipment. Attached background documents provide the bases for determining these endpoints.

2. Chromium: Carcinogenicity

Under the current guidelines, Cr(VI) is classified as a Group A - known human carcinogen by the inhalation route of exposure. Carcinogenicity by the oral route of exposure cannot be determined and thus Cr (VI) is classified as a Group D carcinogen (not classifiable as to human carcinogenicity).[5] Attached background documents provide further discussion in this area.

C. Copper

At this time the Agency is focusing on the risks associated with exposures to arsenic and chromium. Copper is not being considered because of its minimal toxicity to humans under normal environmental exposures and its association with human toxicity only in cases of consumption of water contaminated with high levels of copper, suicide attempts using copper sulfate, or genetic disorders such as Wilson's disease. However, copper will be considered in the environmental risk assessment since the available data indicate that copper is toxic to aquatic organisms.

VI. Exposure Data/Assumptions - An Overview

A. Routes of Exposure

OPP concludes that there are potential dermal and incidental oral exposure concerns relating to child exposure to CCA residues from treated wood playground structures and resulting from leaching of arsenic and chromium compounds into surrounding soil matrices. The potential for adverse dermal and incidental oral exposures to arsenic as *As(V)* and chromium as *Cr(VI)* has prompted the need for the child playground exposure assessment. The Agency believes that available data suggest that the inhalation route of exposure for post-application scenarios, such as

[5] As discussed earlier, the Agency is proposing not to perform an inhalation exposure/risk assessment for children playing on/adjacent to CCA-treated playground equipment.

children playing on CCA-treated structures, may not be significant. OPP has not as yet included an inhalation exposure assessment for arsenic and chromium in its evaluations because it appears that neither arsenic *As(V)* nor chromium *Cr(VI)* residues appear to be volatile on the surfaces of treated wood nor do they appear to be readily available as respirable airborne particulate concentrations. (NOTE: The Agency recognizes that workers exposed in chrome plating plants suffered ulcerations, perforations of the nasal septum and pulmonary function changes. Considering this, whether to perform an inhalation exposure, and eventual risk, assessment for children in playground settings will be a point of discussion for the Panel meeting in October, 2001.)

B. Durations of Exposure

For the children's exposure assessment, OPP is proposing to use exposure estimates for short- (1 day to 1 month) and intermediate-term (1 month to 6 months) exposure scenarios. These estimates will be used to characterize acute and sub-chronic non-cancer hazards to children from contact with CCA residues in wood and soil matrices. We are doing so based on the assumption that short- and intermediate-term exposures of up to 130 days per year may occur for children contacting playground structures and soils. However, for lifetime exposures used to characterize cancer risks, OPP has assumed a duration of 6 years as representative of the time a child might typically spend, over the course of a lifetime, engaged in activities on/near playground structures.

Note that OPP defines short-term exposure duration as lasting from 1 day to 1 month; intermediate-term exposure duration as lasting from 1 to 6 months; and, long-term exposure duration as lasting longer than 6 months (USEPA, OPP/HED Policy Document, June 4, 2001).

C. Children's Exposure Scenarios

Exposures to playground equipment may be considered as representative of worst-case child residential exposures to CCA-treated wood. OPP has developed four exposure scenarios, which are outlined below. A detailed description of each scenario is provided in the accompanying background document on children's exposure.

1. Child Dermal Contact with CCA-Treated Wood Playground Structures;

2. Child Dermal Contact with CCA-Contaminated Soil;

3. Child Incidental Ingestion of Residues Due to Hand-to-Mouth Contact with CCA-Treated Wood Playground Structures; and

VII. Proposed Additional Exposure Data

As part of the CCA-exposure evaluation for playgrounds, the Agency and the Consumer

Product Safety Commission (CPSC) intend to develop sampling regimes that address dislodgeable residues of arsenic and chromium on wood surfaces as well as residues of arsenic and chromium in substrates [soils/buffering materials (e.g., wood chips, pea gravel, shredded rubber)] below/adjacent to CCA-treated playground equipment. CPSC will take the lead on sampling for dislodgeable residues on wood, and USEPA will have responsibility for analyzing soil samples. Collected samples will be analyzed for total arsenic and chromium and in some instances subsamples will be analyzed for speciated forms of arsenic and chromium are (e.g., pentoxide forms, As^{+5}, and trioxide forms, As^{+3}) and chromium (e.g., hexavalent forms, Cr^{+6}, and trivalent forms, Cr^{+3}). The Agency will use the results of these analyses, along with other available exposure data, to develop a more complete exposure assessment and risk characterization for children using CCA-treated playground equipment.

The proposed sampling regime is divided into two parts as follows:

A. Pilot Study

The two agencies are working together to contact random municipalities (and possibly private/public schools/daycare centers) to obtain access to playground sites containing CCA-treated playground equipment. At these playgrounds CPSC/USEPA will sample for: (1) dislodgeable residues of arsenic, chromium, and copper on wood; and (2) residues of arsenic, chromium, and copper in soils and buffering materials (e.g., wood chips) beneath or adjacent to CCA-treated playground structures.[6] Additionally, every effort will be made to obtain records on installation and maintenance of such CCA-treated equipment.

Specifically, CCA-treated playground structures will be randomly selected in one geographic region of the United States (US): e.g., Northeast (NE). In this geographic region three playgrounds containing CCA-treated structures will be located. And at each selected CCA-treated structure, ten soil samples (and ten samples from buffering materials, when present) will be obtained for analyses.

B. Field Study

The two agencies are working together to contact random municipalities (and possibly private/public schools/daycare centers) to obtain permission to sample soil beneath/adjacent to CCA-treated playground structures. Additionally, every effort will be made to obtain records on installation and maintenance of such CCA-treated equipment.

Specifically, CCA-treated playground structures will be randomly selected and replicated in each of three geographic regions of the United States (US): e.g., Northeast (NE), Southeast

[6] Note that the focus of analyses will be on arsenic and chromium. A determination whether to perform analyses for copper will be made by USEPA and CPSC after samples are collected.

(SE), and Southwest (SW). In each geographic region twenty-five playgrounds containing CCA-treated structures will be located. And at each selected CCA-treated structure, ten soil samples (and ten samples from buffering materials, when present) will be obtained for analyses.

VIII. References

ATSDR, 2000b. Toxicological Profile for Chromium. U.S. Department of Health and Human Services. Public Health Service.

Lebow, Stan, 1996. Leaching of Wood Preservative Components and Their Mobility in the Environment, Summary of Pertinent Literature. United States Department of Agriculture, Forest Service, General Technical Report FPL-GTR-93. August, 1996. 36p.

U.S. Environmental Protection Agency. 1998. Series 875 - Occupational and residential exposure test guidelines, Group B - Postapplication exposure monitoring test guidelines, Version 5.4. Office of Pesticide Programs, Health Effects Division. February, 1998.

U.S. Environmental Protection Agency. 2001. Office of Pesticide Programs (OPP), Health Effects Division (HED) Policy Document (Hot Sheet #17), June 4, 2001.