Attachment B

FOR FURTHER INFORMATION CONTACT: Debbie Martin, Boise, ID at phone number 208/321–2959 or e-mail: *debbie.martin@noaa.gov.*

SUPPLEMENTARY INFORMATION: This notice is relevant to the Snake River steelhead (*Oncorhynchus mykiss*) Evolutionarily Significant Unit (ESU).

Background

WDFW has submitted to NMFS an FMEP for inland recreational fisheries potentially affecting listed adults and juveniles of the SR steelhead ESU. These include all freshwater fisheries managed under the sole jurisdiction of the State of Washington occurring within the boundaries of the SR steelhead ESU including the anadromous portions of the Snake River mainstem and tributaries, from the mouth upstream to the Washington-Oregon border. The objective of the fisheries is to harvest known, hatchery-origin steelhead, hatchery spring and fall chinook and other fish species in a manner that does not jeopardize the survival and recovery of the listed SR ESU. All steelhead fisheries included in this FMEP will be managed such that only hatchery-produced adult steelhead that are adipose fin clipped may be retained. Impact levels to the listed SR steelhead ESU are specified in the FMEP. Population risk assessments in the FMEP indicate the extinction risk for the listed ESU under the proposed fishery impact levels to be low. A variety of monitoring and evaluation tasks are specified in the FMEP to assess the abundance of steelhead, determine fishery effort and catch of steelhead, and angler compliance. WDFW will annually conduct a wild population status and a review of the fisheries within the provisions of the FMEP. WDFW will conduct, at a minimum of every 5 years, a comprehensive review to evaluate the effectiveness of the FMEP.

As specified in the July 10, 2000, ESA 4 (d) rule for salmon and steelhead (65 FR 42422), NMFS may approve an FMEP if it meets criteria set forth in § 223.203 (b)(4)(i)(A) through (I). Prior to final approval of an FMEP, NMFS must publish notification announcing its availability for public review and comment.

Authority

Under section 4 of the ESA, the Secretary of Commerce is required to adopt such regulations as he deems necessary and advisable for the conservation of species listed as threatened. The ESA salmon and steelhead 4 (d) rule (65 FR 42422, July 10, 2000) specifies categories of activities that contribute to the conservation of listed salmonids and sets out the criteria for such activities. The rule further provides that the prohibitions of paragraph (a) of the rule do not apply to activities associated with fishery harvest provided that an FMEP has been approved by NMFS to be in accordance with the salmon and steelhead 4 (d) rule.

Dated: July 6 , 2001.

Phil Willliams,

Acting Chief, Endangered Species Division, Office of Protected Resources, National Marine Fisheries Service.

[FR Doc. 01–17576 Filed 7–12–01; 8:45 am]

BILLING CODE 3510–22–S

COMMISSION OF FINE ARTS

Notice of Meeting

The next meeting of the Commission of Fine Arts is scheduled for July 19, 2001 at 10:00 a.m., in the Commission's offices at the National Building Museum, Suite 312, Judiciary Square, 441 F Street, NW., Washington, DC 20001–2728. Items of discussion affecting the appearance of Washington, DC, may include buildings, parks and memorials.

Draft agendas are available to the public one week prior to the meeting. Inquiries regarding the agenda and requests to submit written or oral statements should be addressed to Charles H. Atherton, Secretary, Commission of Fine Arts, at the above address or call 202–504–2200. Individuals requiring sign language interpretation for the hearing impaired should contact the Secretary at least 10 days before the meeting date.

Dated in Washington, DC, July 2, 2001.

Charles H. Atherton,

Secretary.

[FR Doc. 01–17513 Filed 7–12–01; 8:45 am]

BILLING CODE 6330–01–M

CONSUMER PRODUCT SAFETY COMMISSION

Petition HP 01–3 Requesting a Ban on Use of Chromated-Copper-Arsenate (CCA) Treated Wood in Playground Equipment

AGENCY: Consumer Product Safety Commission.

ACTION: Notice.

SUMMARY: The Commission has received a submission that contains a request that the Commission ban use of chromated-copper-arsenate (CCA) treated wood in playground equipment. This request has been docketed as petition under number HP 01–3 under the Federal Hazardous Substances Act (FHSA). The Commission solicits written comments concerning the petition.

DATES: The Office of the Secretary must receive comments on the petition by September 11, 2001.

ADDRESSES: Comments on the petition, preferably in five copies, should be mailed to the Office of the Secretary, Consumer Product Safety Commission, Washington, DC 20207, telephone (301) 504–0800, or delivered to the Office of the Secretary, Room 501, 4330 East-West Highway, Bethesda, Maryland 20814. Comments may also be filed by facsimile to (301) 504–0127 or by e-mail to cpsc-os@cpsc.gov. Comments should be captioned "Petition HP 01–3, Petition for Ban on Use of CCA Treated Wood in Playground Equipment." A copy of the petition is available for inspection at the Commission's Public Reading Room, Room 419, 4330 East-West Highway, Bethesda, Maryland.

FOR FURTHER INFORMATION CONTACT: Rockelle Hammond, Office of the Secretary, Consumer Product Safety Commission, Washington, D.C. 20207; telephone (301) 504–0800, ext. 1232.

SUPPLEMENTARY INFORMATION: The Commission has received correspondence from the Environmental Working Group (EWG) and the Healthy Building Network (HBN) requesting that it issue a ban on use of chromated-copper-arsenate (CCA) treated wood in playground equipment. The petitioners assert that a ban is necessary because "[r]ecent research has shown that arsenic is more carcinogenic than previously recognized, that arsenic is present at significant concentrations on CCA-treated wood and in underlying soil, that the health risks posed by this wood are greater than previously recognized, and that past risk assessments were incomplete."

The Commission is docketing the request for a ban as a petition under provisions of the Federal Hazardous Substances Act (FHSA), 15 U.S.C. 1261–1278.

The submission also requests that the Commission review the safety of CCA-treated wood for general use. This request has not been docketed as part of the petition because this action does not require rulemaking. (The request for a review will be considered separately by the CPSC's Office of Hazard Identification and Reduction.)

Interested parties may obtain a copy of the petition by writing or calling the Office of the Secretary, Consumer

Product Safety Commission, Washington, DC 20207; telephone (301) 504–0800. A copy of the petition is also available for inspection from 8:30 a.m. to 5 p.m., Monday through Friday, in the Commission's Public Reading Room, Room 419, 4330 East-West Highway, Bethesda, Maryland.

Dated: July 9, 2001.

Todd A. Stevenson,

Acting Secretary, Consumer Product Safety Commission.

[FR Doc. 01–17501 Filed 7–12–01; 8:45 am]

BILLING CODE 6355–01–P

DEPARTMENT OF DEFENSE

Office of the Secretary

Submission for OMB Review; Comment Request

ACTION: Notice.

The Department of Defense has submitted to OMB for clearance, the following proposal for collection of information under the provisions of the Paperwork Reduction Act (44 U.S.C. Chapter 35).

Title, Form, and OMB Number: Personnel Security Investigation Projection for Industry Survey; DSS Form 232; OMB Number 0704–0417.

Type of Request: Reinstatement.

Number of Respondents: 11,000.

Responses per Respondent: 1.

Annual Responses: 11,000.

Average Burden per Response: 75 minutes.

Annual Burden Hours: 13,750.

Needs and Uses: Under the National Industrial Security Program (NISP), the Defense Security Service (DSS) is responsible for conducting personnel security investigations (PSIs) of employees of those cleared contractor entities under its security cognizance. The execution of the DSS Form 232 is an essential factor in projecting the needs of cleared contractor entities for PSIs. This collection of information requests the voluntary assistance of the Facility Security Officer to provide projections of the numbers and types of PSIs. The data will be incorporated into DSS budget submissions.

Affected Public: Business or Other For-Profit; Not-For-Profit Institutions.

Frequency: On Occasion.

Respondent's Obligation: Voluntary.

OMB Desk Officer: Mr. Edward C. Springer.

Written comments and recommendations on the proposed information collection should be sent to Mr. Springer at the Office of Management and Budget, Desk Officer for DoD, Room 10236, New Executive Office Building, Washington, DC 20503.

DOD Clearance Officer: Mr. Robert Cushing.

Written requests for copies of the information collection proposal should be sent to Mr. Cushing, WHS/DIOR, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202–4302.

Dated: July 6, 2001.

Patricia L. Toppings,

Alternate OSD Federal Register Liaison Officer, Department of Defense.

[FR Doc. 01–17508 Filed 7–12–01; 8:45 am]

BILLING CODE 5001–08–M

DEPARTMENT OF DEFENSE

Department of the Army

Inland Waterways Users Board

AGENCY: Department of the Army, DOD.

ACTION: Notice of request for nominations.

SUMMARY: Section 302 of Public Law (Pub. L.) 99–662 established the Inland Waterways Users Board. The Board is an independent Federal advisory committee. Its 11 members are appointed by the Secretary of the Army. This notice is to solicit nominations for five (5) appointments or reappointments to two-year terms that will begin January 1, 2002.

ADDRESSES: Office of the Assistant Secretary of the Army (Civil Works), Department of the Army, Washington, DC 20310–0103. Attention: Inland Waterways Users Board Nominations Committee.

FOR FURTHER INFORMATION CONTACT: Office of the Assistant Secretary of the Army (Civil Works) (703) 697–8986.

SUPPLEMENTARY INFORMATION: The selection, service, and appointment of Board members are covered by provisions of Section 302 of Pub. L. 99–662. The substance of those provisions is as follows:

a. *Selection.* Members are to be selected from the spectrum of commercial carriers and shippers using the inland and intracoastal waterways, to represent geographical regions, and to be representative of waterborne commerce as determined by commodity ton-miles statistics.

b. *Service.* The Board is required to meet at least semi-annually to develop and make recommendations to the Secretary of the Army on waterways construction and rehabilitation priorities and spending levels for commercial navigation improvements, and report its recommendations annually to the Secretary and Congress.

c. *Appointment.* The operation of the Board and appointment of its members are subject to the Federal Advisory Committee Act (Pub. L. 92–463, as amended) and departmental implementing regulations. Members serve without compensation but their expenses due to Board activities are reimbursable. The considerations specified in Section 302 for the selection of the Board members, and certain terms used therein, have been interpreted, supplemented, or otherwise clarified as follows:

(1) *Carriers and Shippers.* The law uses the terms "primary users and shippers." Primary users has been interpreted to mean the providers of transportation services on inland waterways such as barge or towboat operators. Shippers has been interpreted to mean the purchasers of such services for the movement of commodities they own or control. Individuals are appointed to the Board, but they must be either a carrier or shipper, or represent a firm that is a carrier or shipper. For that purpose a trade or regional association is neither a shipper or primary user.

(2) *Geographical Representation.* The law specifies "various" regions. For the purpose of selecting Board members, the waterways subjected to fuel taxes and described in Pub. L. 95–502, as amended, have been aggregated into six regions. They are (1) the Upper Mississippi River and its tributaries above the mouth of the Ohio; (2) the Lowe Mississippi River and its tributaries below the mouth of the Ohio and above Baton Rouge; (3) the Ohio River and its tributaries; (4) the Gulf Intracoastal Waterway in Louisiana and Texas; (5) the Gulf Intracoastal Waterway east of New Orleans and associated fuel-taxed waterways including the Tennessee-Tombigbee, plus the Atlantic Intracoastal Waterway below Norfolk; and (6) the Columbia-Snake Rivers System and Upper Willamette. The intent is that each region shall be represented by at least one Board member, with that representation determined by the regional concentration of the individual's traffic on the waterways.

(3) *Commodity Representation.* Waterway commerce has been aggregated into six commodity categories based on "inland" ton-miles shown in Waterborne Commerce of the United States. These categories are (1) Farm and Food Products; (2) Coal and Coke; (3) Petroleum, Crude and Products; (4) Minerals, Ores, and Primary Metals and Mineral Products; (5) Chemicals and Allied Products; and (6) All other. A consideration in the

Attachment C

List of Respondents to the FR Request for Comments on CPSC Petition HP 01-3 Requesting Ban on Use of CCA Treated Wood in Playground Equipment (66 FR: 36756)	
Generation Green (and approximately 3,000 consumers affiliated with Generation Green)	Beyond Pesticides
R. Gilstein (consumer)	Leathers and Associates
D. Marcelius (consumer)	Seminole Tribes of Florida
Brian Fink (consumer)	Wisconsin State Department of Agriculture, Trade, and Consumer Protection
Nina Derda (consumer)	Connecticut Department of Public Health
Edward Hoy (consumer)	Connecticut Agriculture Experiment Station
Eloise Gumpert (consumer)	Steptoe and Johnson, on behalf of the American Chemistry Council and American Wood Preservers Institute
Julia Holladay (consumer)	American Forest and Paper Association
Joseph Prager (consumer)	Connecticut Department of Public Health
Jonathan Held (consumer)	
Emily Sims (consumer)	
Marge Folino (consumer)	
C. Stomber (consumer)	
V. Christie (consumer)	
Ruthann Spence (consumer)	
Thomas French (consumer)	
Karen Pushinsky (consumer)	
Robert Davis (consumer)	
Jeff Hobson (consumer)	
Terri Becker (consumer)	

Attachment D

see 65 FR 69910, published on November 21, 2000.

D. Michael Hutchinson,

Acting Chairman, Committee for the Implementation of Textile Agreements.

Committee for the Implementation of Textile Agreements

September 14, 2001.

Commissioner of Customs,
Department of the Treasury, Washington, DC 20229.

Dear Commissioner: This directive amends, but does not cancel, the directive issued to you on November 15, 2000, by the Chairman, Committee for the Implementation of Textile Agreements. That directive concerns imports of certain cotton, man-made fiber, silk blend and other vegetable fiber textiles and textile products, produced or manufactured in Bangladesh and exported during the twelve-month period which began on January 1, 2001 and extends through December 31, 2001.

Effective on September 20, 2001, you are directed to adjust the limits for the following categories, as provided for under the Uruguay Round Agreement on Textiles and Clothing:

Category	Adjusted twelve-month limit [1]
237	484,073 dozen.
334	173,286 dozen.
335	164,515 dozen.
338/339	2,188,286 dozen.
340/640	4,478,326 dozen.
341	3,449,818 dozen.
351/651	1,019,420 dozen.
634	813,842 dozen.
635	482,421 dozen.
638/639	2,123,898 dozen.
641	790,213 dozen.
645/646	445,495 dozen.
847	427,397 dozen.

[1] – thnsp;The limits have not been adjusted to account for any imports exported after December 31, 2000.

The Committee for the Implementation of Textile Agreements has determined that these actions fall within the foreign affairs exception of the rulemaking provisions of 5 U.S.C. 553(a)(1).

Sincerely,
D. Michael Hutchinson,
Acting Chairman, Committee for the Implementation of Textile Agreements.

[FR Doc.01-23362 Filed 9-19-01; 8:45 am]

BILLING CODE 3510-DR-F

CONSUMER PRODUCT SAFETY COMMISSION

[HP 01-3]

ENVIRONMENTAL PROTECTION AGENCY

[OPP-00741; FRL-6802-8]

Draft Sampling Protocols for Chromated Copper Arsenate (CCA) Pressure-Treated Playground Equipment and Related Soil; Notice of Availability

AGENCIES: Consumer Product Safety Commission (CPSC). Environmental Protection Agency (EPA).

ACTION: Notice.

SUMMARY: This notice announces the availability of draft sampling and analysis protocols developed cooperatively by CPSC and EPA to collect and analyze dislodgeable residues of arsenic, chromium and copper from Chromated Copper Arsenate (CCA) pressure-treated playground equipment (dislodgeable residues protocol) and soil residues of arsenic, chromium and copper in soils beneath/adjacent to CCA-treated playground equipment (soil residues protocol). The studies to be conducted using these protocols will assist both Agencies in assessing exposure that can be expected for children playing on/around CCA-treated playground equipment. By providing notice and opportunity for comment on the protocols, the Agencies are seeking to strengthen stakeholder involvement and help ensure that their decisions are transparent and based on the best available information.

DATES: Comments must be received on or before October 22, 2001.

ADDRESSES: Comments may be submitted by mail, electronically, or by hand delivery. Please follow the detailed instructions provided in Unit I of the SUPPLEMENTARY INFORMATION.

FOR FURTHER INFORMATION CONTACT:

1. Draft Dislodgeable Residues Protocol

For further information on the draft dislodgeable residues protocol contact: Patricia Bittner, Directorate for Health Sciences, Consumer Product Safety Commission, Washington, DC 20207; telephone number: (301) 504-0477, ext. 1184; fax number (301) 504-0079; e-mail address: pbittner@cpsc.gov.

2. Draft Soil Residues Protocol

For further information on the draft soil residues protocol contact: Norm Cook, Antimicrobials Division (7510C), Office of Pesticide Programs, Environmental Protection Agency, 1200 Pennsylvania Ave., NW., Washington, DC 20460; telephone number: (703) 308-8253; fax number: (703)308-8481; e-mail address: cook.norm@epa.gov.

SUPPLEMENTARY INFORMATION:

I. General Information

A. Does This Action Apply to Me?

This action is directed to the public in general. This action may, however, be of particular interest to: Wood treaters; manufactures of CCA; wholesalers, distributors, and retailers of CCA-treated lumber and products made with CCA-treated lumber; and consumers purchasing and using CCA-treated lumber or CCA-treated lumber products. The Agencies are obtaining expert scientific peer review of the draft sampling and analysis protocols through EPA's contractor, Versar, but would also like to afford the general public an opportunity to comment on the study design prior to initiation of the actual sampling and analyses. All comments (Versar and public) will be carefully considered and made available in both CPSC's and EPA's dockets. Since other entities may also be interested, the Agencies have not attempted to describe all specific entities that may be affected by this action. If you have any questions regarding the applicability of this action to a particular entity, consult one of the persons listed under FOR FURTHER INFORMATION CONTACT.

B. How Can I Get Additional Information, Including Copies of the Draft Protocols and Other Related Documents?

1. *Electronically.* You may obtain electronic copies of the draft protocols, and certain other related information that might be available electronically, from the CPSC Internet Home Page at http://www.cpsc.gov. To access these documents and information on the CPSC Home page, select "Library (FOIA)," "Electronic Reading Room—Freedom of Information Act Information," "2001 FOIA Information," and "Commission Briefing Packages." Then scroll down to the materials designated with the name of this notice.

You may also access the draft protocols and related information from the EPA Internet Home Page at http://www.epa.gov/. To do so on the EPA Home Page, select "Laws and Regulations," "Regulations and Proposed Rules," and then look up the entry for this document under the "Federal Register—Environmental Documents." You can also go directly to the Federal Register listings at *http://www.epa.gov/fedrgstr/.*

2. In person. Copies of the draft protocols and related information may be obtained from the CPSC Office of the Secretary, Room 502, 4330 East-West Highway, Bethesda, MD; telephone number: (301) 504–0127; e-mail address: cpsc-os@cpsc.gov.

Copies of the draft protocols and related information may also be obtained from EPA. EPA has established an official record for this action under docket control number OPP–00741. The official record consists of the documents specifically referenced in this action, any public comments received during an applicable comment period, and other information related to this action, including any information claimed as Confidential Business Information (CBI). This official record includes the documents that are physically located in the docket, as well as the documents that are referenced in those documents. The public version of the official record does not include any information claimed as CBI. The public version of the official record, which includes printed, paper versions of any electronic comments submitted during an applicable comment period, is available for inspection in the Public Information and Records Integrity Branch (PIRIB), Rm. 119, Crystal Mall #2, 1921 Jefferson Davis Hwy., Arlington, VA, from 8:30 a.m. to 4 p.m., Monday through Friday, excluding legal holidays. The PIRIB telephone number is (703) 305–5805.

C. To Whom and How Do I Submit Comments?

1. Comments to CPSC on Draft Dislodgeable Residues Protocol

a. General. Comments on the draft dislodgeable residues protocol should be submitted to the Office of the Secretary, Consumer Product Safety Commission, Washington, DC 20207–0001, or delivered to the Office of the Secretary, Consumer Product Safety Commission, Room 502, 4330 East-West Highway, Bethesda, MD 20814, telephone number: (301) 504–0800. Comments on the draft dislodgeable residues protocol also may be filed by facsimile to (301) 504–0127 or by e-mail to cpsc-os@cpsc.gov. Comments on the draft dislodgeable residues protocol should be captioned "Notice of Availability of Draft Dislodgeable Residues Protocol."

b. How should I Handle CBI that I Want to Submit to CPSC? Any person responding to the CPSC who believes that any information submitted is CBI (i.e., trade secret or proprietary) should specifically identify the exact portions of the document claimed to be confidential. The Commission's staff will receive and handle such information confidentially and in accordance with section 6(a) of the Consumer Product Safety Act (CPSA), 15 U.S.C. 2055(a). Such information will not be placed in the public docket for the rulemaking and will not be made available to the public simply upon request. If the Commission receives a request for disclosure of the information or concludes that its disclosure is necessary to discharge the Commission's responsibilities, the Commission will inform the person who submitted the information and provide that person with an opportunity to present additional information and views concerning the confidential nature of the information. 16 CFR 1015.18(b).

The Commission's staff will then make a determination as to whether the information is a trade secret or proprietary information that cannot be released. That determination will be made in accordance with applicable provisions of the CPSA; the Freedom of Information Act (FOIA), 5 U.S.C. 552b; 18 U.S.C. 1905; the Commission's procedural regulations at 16 CFR part 1015 governing protection and disclosure of information under provisions of FOIA; and relevant judicial interpretations. If the Commission concludes that any part of the information that has been submitted with a claim that the information is a trade secret or proprietary is disclosable, it will notify the person submitting the material in writing and provide at least 10 calendar days from the receipt of the letter to allow for that person to seek judicial relief. 15 U.S.C. 2055(a)(5) and (6); 16 CFR 1015.19(b).

2. Comments to EPA on Draft Soil Residues Protocol. Comments on the draft soil residues protocol should be submitted to EPA. To ensure proper receipt by EPA of comments, it is imperative that you identify docket control number OPP–00741 in the subject line on the first page of your response.

a. By mail. Submit your comments to: Public Information and Records Integrity Branch (PIRIB), Information Resources and Services Division (7502C), Office of Pesticide Programs (OPP), Environmental Protection Agency, 1200 Pennsylvania Ave., NW., Washington, DC 20460.

b. In person or by courier. Deliver your comments to: Public Information and Records Integrity Branch (PIRIB), Information Resources and Services Division (7502C), Office of Pesticide Programs (OPP), Environmental Protection Agency, Rm. 119, Crystal Mall #2, 1921 Jefferson Davis Hwy., Arlington, VA. The PIRIB is open from 8:30 a.m. to 4 p.m., Monday through Friday, excluding legal holidays. The PIRIB telephone number is (703) 305–5805.

c. Electronically. You may submit your comments electronically by e-mail to: opp-docket@epa.gov, or you can submit a computer disk as described in this unit. Do not submit any information electronically that you consider to be CBI. Avoid the use of special characters and any form of encryption. Electronic submissions will be accepted in WordPerfect 6.1/8.0 or ASCII file format. All comments in electronic form must be identified by docket control number OPP–00741. Electronic comments may also be filed online at many Federal Depository Libraries.

d. How Should I Handle CBI that I Want to Submit to EPA? Do not submit any information electronically that you consider to be CBI. You may claim information that you submit to EPA in response to this document as CBI by marking any part or all of that information as CBI. Information so marked will not be disclosed except in accordance with procedures set forth in 40 CFR part 2. In addition to one complete version of the comment that includes any information claimed as CBI, a copy of the comment that does not contain the information claimed as CBI must be submitted for inclusion in the public version of the official record. Information not marked confidential will be included in the public version of the official record without prior notice. If you have any questions about CBI or the procedures for claiming CBI, please consult the person listed under FOR FURTHER INFORMATION CONTACT.

D. What Should I Consider as I Prepare My Comments?

You may find the following suggestions helpful for preparing your comments:

1. Explain your views as clearly as possible.
2. Describe any assumptions that you used.
3. Provide copies of any technical information and/or data you used that support your views.
4. If you estimate potential burden or costs, explain how you arrived at the estimate that you provide.
5. Provide specific examples to illustrate your concerns.
6. Offer alternative ways to improve the rule or collection activity.
7. Make sure to submit your comments by the deadline in this notice.
8. To ensure proper receipt by the Agency, be sure to properly identify the

comments in the subject line on the first page of your response. You may also provide the name, date, and Federal Register citation.

II. What Actions Are the Agencies Taking?

A. CPSC

The CPSC received a petition from the Environmental Working Group (EWG) and the Healthy Building Network (HBN) requesting a ban on the use of CCA treated wood in playground equipment. The petitioners assert that a ban is necessary because "[r]ecent research has shown that arsenic is more carcinogenic than previously recognized, that arsenic is present at significant concentrations on CCA-treated wood and in underlying soil, that the health risks posed by this wood are greater than previously recognized, and that past risk assessments were incomplete."

The Commission docketed the request for a ban as a petition under provisions of the Federal Hazardous Substances Act (FHSA), 15 U.S.C. 1261–1278. The EWG/HBN submission also requested that the Commission review the safety of CCA-treated wood for general use. That request was not docketed as part of the petition because it would not require rulemaking. The request for a review is being considered separately by the CPSC's Office of Hazard Identification and Reduction. The Commission published notice of docketing of the EWG/HBN petition in the Federal Register of July 13, 2001 (66 FR 36756). The public comment period on that notice closed on September 11, 2001.

As part of its response to the EWG/HBN petition, the CPSC, in cooperation with EPA, has developed the draft dislodgeable residues protocol that is the subject of this notice. CPSC will use the results of the study to be conducted under the protocol in its further evaluation of the potential exposure and any associated risks to children who come in contact with CCA-treated wood.

B. EPA

As part of the reregistration process for heavy duty wood preservatives (including pentachlorophenol, creosote, and CCA) under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), the EPA is evaluating the human and environmental risks of CCA. Since CCA-treated wood can be used in both commercial and residential settings, EPA intends to evaluate all uses of CCA-treated wood. Because of specific concerns associated with use of CCA-treated wood in playground equipment, the Agency is presently evaluating available exposure and hazards data in order to determine the risks to children who come in contact with CCA-treated wood and CCA-contaminated soil.

As part of the CCA-exposure evaluation, EPA, in cooperation with the CPSC, is developing a sampling regime that addresses potential soil residues of arsenic, chromium, and copper which may occur in soils below/adjacent to CCA-treated playground equipment. The draft protocol for that sampling regime is the subject of this notice.

List of Subjects

Consumer protection, Environmental protection, Arsenic, Chromated copper arsenate, Chromium, Copper, Hazardous substances, Pesticides and pests, Playgrounds, Soil.

Dated: September 13, 2001.

Todd A. Stevenson,

Acting Secretary, Office of the Secretary, Consumer Product Safety Commission.

Dated: September 14, 2001.

Frank Sanders,

Director, Antimicrobials Division, Office of Pesticide Programs, Environmental Protection Agency.

[FR Doc. 01–23409 Filed 9–19–01; 8:45 am]

BILLING CODE 6355–01–P; 6560–P

DEPARTMENT OF DEFENSE

Office of the Secretary

Deterrence Concepts Advisory Group

AGENCY: DoD.

ACTION: Notice of Advisory Committee meeting.

SUMMARY: The Deterrence Concepts Advisory Group will meet in closed session on September 20, 2001. The committee was established to provide advice and recommendations to the Secretary of Defense on advancing a strong, secure, and persuasive U.S. force for freedom and progress in the world, and to do so at the lowest nuclear force level consistent with security requirements.

In accordance with the Federal Advisory Committee Act, Public Law No. 92–463, as amended [5 U.S.C. App II (1982)], it has been determined that the committee meeting concerns matters sensitive to the interest of national security, listed in 5 U.S.C. 552B(c)(1)(1982) and accordingly this meeting was closed to the public.

DATES: September 20, 2001, 2 p.m.

ADDRESSES: The Pentagon, Washington, DC.

FOR FURTHER INFORMATION CONTACT: Lauren Haber, OUSD (Policy), 703–697–0286.

Dated: September 13, 2001.

L. M. Bynum,

Alternate Federal Register Liaison Officer, Department of Defense.

[FR Doc. 01–23373 Filed 9–19–01; 8:45 am]

BILLING CODE 5001–08–M

DEPARTMENT OF DEFENSE

Office of the Secretary

Deterrence Concepts Advisory Group

AGENCY: DoD.

ACTION: Notice of advisory committee meeting.

SUMMARY: The Deterrence Concepts Advisory Group will meet in closed session on September 27, 2001. The committee was established to provide advice and recommendations to the Secretary of Defense on advancing a strong, secure, and persuasive U.S. force for freedom and progress in the world, and to do so at the lowest nuclear force level consistent with security requirements.

In accordance with the Federal Advisory Committee Act, Public Law 92–463, as amended [5 U.S.C. App II (1982)], it has been determined that the committee meeting concerns matters sensitive to the interest of national security, listed in 5 U.S.C. 552B(c)(1)(1982) and accordingly this meeting was closed to the public.

DATES: September 27, 2001, 1 p.m.

ADDRESSES: The Pentagon, Washington, DC.

FOR FURTHER INFORMATION CONTACT: Lauren Haber, OUSD (Policy), 703–697–0286.

Dated: September 13, 2001.

L.M. Bynum,

Alternate Federal Register Liaison Officer, Department of Defense.

[FR Doc. 01–23374 Filed 9–19–01; 8:45 am]

BILLING CODE 5001–08–M

DEPARTMENT OF DEFENSE

Office of the Secretary

Domestic Advisory Panel (DAP) on Early Intervention and Education for Infants, Toddlers, Preschool Children, and Children With Disabilities; Meeting

AGENCY: Department of Defense Domestic Dependent Elementary and Secondary Schools (DDESS).

ACTION: Notice.

Attachment E

List of Respondents to the FR Request for Comments on Draft Sampling Protocols for CCA-Treated Playground Equipment and Related Soil (66 FR: 48428)	
Jack Eislin (consumer)	American Wood Preservers Institute
Florida Bureau of Waste Cleanup	American Chemistry Council

TAB D

ENVIRONMENTAL PROTECTION AGENCY

[OPP–66300; FRL–6826–8]

Notice of Receipt of Requests to Cancel Certain Chromated Copper Arsenate (CCA) Wood Preservative Products and Amend to Terminate Certain Uses of CCA Products

AGENCY: Environmental Protection Agency (EPA).

ACTION: Notice.

SUMMARY: Pursuant to section 6(f)(1) of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as amended, EPA is issuing a notice of receipt of requests from registrants of affected chromated copper arsenate (CCA) products to cancel certain products and to amend to terminate certain uses of other CCA products. These requests were submitted to EPA in February 2002. EPA intends to grant these requests at the close of the comment period for this announcement unless the Agency receives substantive comments within the comment period that would merit its further review of these requests. Upon acceptance of these requests, any sale, distribution, or use of products listed in this notice will only be permitted if such distribution, sale, or use is consistent with the terms as described in this notice.

DATES: Comments must be received on or before March 25, 2002.

ADDRESSES: Comments may be submitted by mail, electronically, or in person. Please follow the detailed instructions for each method as provided in Unit I. of the **SUPPLEMENTARY INFORMATION**. To ensure proper receipt by EPA, it is imperative that you identify docket control number OPP–66300 in the subject line on the first page of your response.

FOR FURTHER INFORMATION CONTACT: By mail: Bonaventure Akinlosotu, Antimircrobial Division (7510C), Office of Pesticide Programs, Environmental Protection Agency, 1200 Pennsylvania Avenue, NW., Washington, DC 20460.

Office location for commercial courier delivery, telephone number, and e-mail address: Rm. 308, Crystal Mall #2, 1921 Jefferson Davis Highway, Arlington, VA 22202, (703) 605–0653; e-mail: akinlosotu.bonaventure@epa.gov.

SUPPLEMENTARY INFORMATION: This announcement consists of five parts. The first part contains general information. The second part addresses the registrants' requests for registration cancellations and amendments to terminate uses. The third part describes the action taken by this notice. The fourth part describes the Agency's legal authority for the action announced in this notice. The fifth part proposes existing stocks provisions that the Agency intends to authorize.

I. General Information

A. Does this Action Apply to Me?

This action is directed to the public in general. You may be potentially affected by this action if you manufacture, sell, distribute, or use CCA products. The Congressional Review Act, 5 U.S.C. 801 *et seq.*, as added by the Small Business Regulatory Enforcement Fairness Act of 1996, does not apply because this action is not a rule, for purposes of 5 U.S.C. 804(3). Since other entities may also be interested, the Agency has not attempted to describe all the specific entities that may be affected by this action. If you have any questions regarding the applicability of this action to a particular entity, consult the person listed under **FOR FURTHER INFORMATION CONTACT**.

B. How Can I Get Additional Information, Including Copies of this Document and Other Related Documents?

1. *Electronically.* You may obtain electronic copies of this document, and certain other related documents that might be available electronically, from the EPA Internet Home Page at http://www.epa.gov/. To access this document, on the Home Page select "Laws and Regulations," "Regulations and Proposed Rules" and then look up the entry for this document under the "**Federal Register**—Environmental Documents." You can also go directly to the **Federal Register** listings at http://www.epa.gov/fedrgstr/.

2. *In person.* The Agency has established an official record for this action under docket control number OPP–66300. The official record consists of the documents specifically referenced in this action, any public comments received during an applicable comment period, and other information related to this action, including any information claimed as Confidential Business Information (CBI). This official record includes the documents that are physically located in the docket, as well as the documents that are referenced in those documents. The public version of the official record does not include any information claimed as CBI. The public version of the official record, which includes printed, paper versions of any electronic comments submitted during an applicable comment period, is available for inspection in the Public Information and Records Integrity Branch (PIRIB), Rm. 119, Crystal Mall #2, 1921 Jefferson Davis Hwy., Arlington, VA, from 8:30 a.m. to 4 p.m., Monday through Friday, excluding legal holidays. The PIRIB telephone number is (703) 305–5805.

C. How and to Whom Do I Submit Comments?

You may submit comments through the mail, in person, or electronically. To ensure proper receipt by EPA, it is imperative that you identify docket control number OPP–66300 in the subject line on the first page of your response.

1. *By mail.* Submit your comments to: Public Information and Records Integrity Branch (PIRIB), Information Resources and Services Division (7502C), Office of Pesticide Programs (OPP), Environmental Protection Agency, 1200 Pennsylvania Ave., NW., Washington, DC 20460.

2. *In person or by courier.* Deliver your comments to: Public Information and Records Integrity Branch (PIRIB), Information Resources and Services Division (7502C), Office of Pesticide Programs (OPP), Environmental Protection Agency, Rm. 119, Crystal Mall #2, 1921 Jefferson Davis Hwy., Arlington, VA. The PIRIB is open from 8:30 a.m. to 4 p.m., Monday through Friday, excluding legal holidays. The PIRIB telephone number is (703) 305–5805.

3. *Electronically.* You may submit your comments electronically by e-mail to: opp-docket@epa.gov, or you can submit a computer disk as described above. Do not submit any information electronically that you consider to be CBI. Avoid the use of special characters and any form of encryption. Electronic submissions will be accepted in WordPerfect 6.1/8.0 or ASCII file format. All comments in electronic form must be identified by docket control number OPP–66300. Electronic comments may also be filed online at many Federal Depository Libraries.

D. How Should I Handle CBI that I Want to Submit to the Agency?

Do not submit any information electronically that you consider to be CBI. You may claim information that you submit to EPA in response to this document as CBI by marking any part or all of that information as CBI. Information so marked will not be disclosed except in accordance with procedures set forth in 40 CFR part 2. In addition to one complete version of the comment that includes any information claimed as CBI, a copy of the comment that does not contain the

information claimed as CBI must be submitted for inclusion in the public version of the official record. Information not marked confidential will be included in the public version of the official record without prior notice. If you have any questions about CBI or the procedures for claiming CBI, please consult the person listed under **FOR FURTHER INFORMATION CONTACT.**

E. What Should I Consider as I Prepare My Comments for EPA?

You may find the following suggestions helpful for preparing your comments:

1. Explain your views as clearly as possible.
2. Describe any assumptions that you used.
3. Provide copies of any technical information and/or data you used that support your views.
4. If you estimate potential burden or costs, explain how you arrived at the estimate that you provide.
5. Provide specific examples to illustrate your concerns.
6. Offer alternative ways to improve the notice or collection activity.
7. Make sure to submit your comments by the deadline in this notice.
8. To ensure proper receipt by EPA, be sure to identify the docket control number assigned to this action in the subject line on the first page of your response. You may also provide the name, date, and**Federal Register** citation.

II. Background of the Receipt of Requests to Cancel and Amend Registrations to Delete Uses

As a result of current and projected market demand and the availability of new generation wood treatment products, the below identified four registrants of CCA products have requested EPA to cancel certain affected products and to amend to terminate uses of the other pesticide registrations of the products identified in this notice (Tables 1 and 2). The letter from Arch Wood Protection, Inc. was dated February 5, 2002; from Chemical Specialties, Inc., dated February 4, 2002; from Osmose, Inc., dated February 6, 2002; and from Phibro-Tech, Inc., dated February 6, 2002. Specifically, the Agency has received a request to cancel two products, and requests to amend other affected end-use and manufacturing-use registrations to terminate all uses of such products with the exception of the treatment of forest products that fall under the American Wood Preservers Association (AWPA) standards listed as stated below in the text of the requested label amendments.

For affected manufacturing-use products, the label amendments would read as follows:

Effective December 31, 2003, this product may only be used (1) for formulation of the following end-use wood preservative products: ACZA or CCA labeled in accordance with the "Directions for Use" shown below, or (2) by persons other than the registrant, in combination with one or more other products to make: ACZA wood preservative; or CCA wood preservative that is used in accordance with the "Directions for Use" shown below.

Effective December 31, 2003, this product may only be used for preservative treatment of the following categories of forest products and in accordance with the respective cited standard (noted parenthetically) of the 2001 edition of the American Wood Preservers' Association Standards: Lumber and Timber for Salt Water Use Only (C2), Piles (C3), Poles (C4), Plywood (C9), Wood for Highway Construction (C14), Poles, Piles and Posts Used as Structural Members on Farms, and Plywood Used on Farms (C16), Wood for Marine Construction (C18), Round Poles and Posts Used in Building Construction (C23), Sawn Timber Used To Support Residential and Commercial Structures (C24), Sawn Crossarms (C25), Structural Glued Laminated Members and Laminations Before Gluing (C28), Structural Composite Lumber (C33), and Shakes and Shingles (C34). Forest products treated with this product may only be sold or distributed for uses within the AWPA Commodity Standards under which the treatment occurred.

For affected end-use products, the label amendments would read as follows:

Effective December 31, 2003, this product may only be used for preservative treatment of the following categories of forest products and in accordance with the respective cited standard (noted parenthetically) of the 2001 edition of the American Wood Preservers' Association Standards: Lumber and Timber for Salt Water Use Only (C2), Piles (C3), Poles (C4), Plywood (C9), Wood for Highway Construction (C14), Poles, Piles and Posts Used as Structural Members on Farms, and Plywood Used on Farms (C16), Wood for Marine Construction (C18), Round Poles and Posts Used in Building Construction (C23), Sawn Timber Used To Support Residential and Commercial Structures (C24), Sawn Crossarms (C25), Structural Glued Laminated Members and Laminations Before Gluing (C28), Structural Composite Lumber (C33), and Shakes and Shingles (C34). Forest products treated with this product may only be sold or distributed for uses within the AWPA Commodity Standards under which the treatment occurred.

In addition, the registrants requested that EPA allow use of the previous (unamended) labels for a period of 60 calendar days from the date on which the particular affected registrant receives EPA's approval of the amendments, and that EPA allow a further amendment by notification on or before December 1, 2003 to: (1) Delete the use directions in effect prior to these amendments, and (2) to delete the statement "Effective December 31, 2003" from the amended labels approved by EPA. Furthermore, the registrants stated in their letters that they will not amend or withdraw their requests before EPA acts on them. The registrants also intend to notify their customers of the amended labels by certified mail after EPA acts on the request.

The registrants also estimate that during the first year following acceptance of the amendments by EPA, sales of new generation wood treatment products are likely to increase to 15% to 25% of the total average sales during 1999, 2000, and 2001 of the products identified in Tables 1 and 2 for the non-industrial treatment categories subject to these amendments, and are estimated to increase to 60% to 70% of the same total average sales for these treatment categories subject to these amendments during the second year following acceptance of the amendments by EPA. Further, the registrants estimate that during the first year following acceptance of the amendments by EPA, sales of the products identified in Tables 1 and 2 are likely to decrease by 15% to 25% of their total average sales during 1999, 2000, and 2001 for the non-industrial treatment categories subject to the amendments, and are estimated to decrease by 60% to 70% of the same total average sales during 1999, 2000, and 2001 for these treatment categories subject to the amendments during the second year following acceptance of the amendments by EPA.

III. What Action is the Agency Taking?

This notice announces receipt by the Agency under section 6(f)(1) of FIFRA from the four identified registrants of CCA products of requests to cancel two affected products and to amend other affected CCA product registrations to terminate all uses with the exception of the treatment of forest products listed above. The affected products and the registrants making the requests are identified in Tables 1 - 3 below.

TABLE 1.—REGISTRATIONS WITH REQUESTS FOR AMENDMENTS TO TERMINATE USES

Registration Number	Product Name
End Use Products	
3008-17	K-33-C (72%) Wood Preservative

TABLE 1.—REGISTRATIONS WITH REQUESTS FOR AMENDMENTS TO TERMINATE USES—Continued

Registration Number	Product Name
3008-21	Special K-33 Preservative
3008-34	K-33 (60%) Wood Preservative
3008-35	K-33 (40%) Type-B Wood Preservative
3008-36	K-33-C (50%) Wood Preservative
3008-42	K-33-A (50%) Wood Preservative
3008-72	Osmose Arsenic Acid 75%
10465-26	CCA Type-C Wood Preservative 50%
10465-28	CCA Type-C Wood Preservative 60%
10465-32	CSI Arsenic Acid 75%
35896-2	Wood-Last Conc. Wood Preservation AQ 50% Solution CCA-Type A
62190-2	Wolmanac® Concentrate 50%
62190-8	Wolmanac® Concentrate 72%
62190-14	Wolmanac® Concentrate 60%
Manufacturing Use Products	
3008-66	Arsenic Acid 75%
10465-32	CSI Arsenic Acid 75%
62190-7	Arsenic Acid 75%

TABLE 2.—REGISTRATIONS WITH REQUESTS FOR CANCELLATION OF PRODUCTS

Registration Number	Product Name
62190-5	WolmanacR Concentrate 70%
62190-11	CCA Type C 50% Chromated Copper Arsenate

Table 3 below includes the names and addresses of record for all registrants of the products in Tables 1 and 2.

TABLE 3.—REGISTRANTS REQUESTING VOLUNTARY TERMINATION OF USES AND/OR CANCELLATION OF PRODUCTS

EPA Company No.	Company Name and Address
003008	Osmose, Inc. 980 Ellicott Street Buffalo, NY 14209
010465	Chemical Specialties. Inc. One Woodlawn Green, Suite 250 200 E. Woodlawn Road Charlotte, NC 28217
035896	Phibro-Tech, Inc. One Parker Plaza Fort Lee, NJ 07024
062190	Arch Wood Protection, Inc. 1955 Lake Park Drive, Suite 250 Smyrna, GA 30080

IV. What is the Agency's Authority for Taking This Action?

Section 6(f)(1) of FIFRA provides that a registrant of a pesticide product may at any time request that a pesticide registration of the registrant be canceled or amended to terminate one or more uses. The Act further provides that, before acting on the request, EPA must publish a notice of receipt of any such request in the **Federal Register**. Thereafter, following the public comment period, the Administrator may approve such a request.

V. Provisions for Disposition of Existing Stocks

In any order issued in response these requests for amendment to terminate uses, the Agency proposes to include the following provisions for the treatment of any existing stocks of the products identified or referenced in Table 1:

All distribution, sale, and use of existing stocks of affected manufacturing-use and end-use products will be unlawful under FIFRA effective December 31, 2003, except for purposes of shipping such stocks for relabeling or repackaging, export consistent with the requirements of section 17 of FIFRA, or proper disposal, unless such stocks have been relabeled or repackaged in a manner that is consistent with this order.

In any order issued in response to the above-noted a request for cancellation of a product registration, the Agency proposes to not grant any period of time for disposition of existing stocks of the products for which cancellation was requested as identified or referenced in Table 2.

List of Subjects

Environmental protection, Pesticides and pests

Dated: February 15, 2002.

Frank Sanders,

Director, Antimicrobial Division, Office of Pesticide Programs.

[FR Doc. 02–4306 Filed 2–21–02; 8:45 am]

BILLING CODE 6560–50–S

ENVIRONMENTAL PROTECTION AGENCY

[FRL–7145–7]

Privacy Act of 1974: Republication of Existing System of Records

AGENCY: Environmental Protection Agency.

ACTION: Notice; Amendment to notice of privacy act system of records.

SUMMARY: The Environmental Protection Agency (EPA) is proposing to amend the existing Privacy Act system of records.

EFFECTIVE DATES: The proposed amendments will be effective upon publication.

ADDRESSES: Send written comments to Judy E. Hutt, Agency Privacy Act Officer, 1200 Pennsylvania Ave. (2822) Washington, DC 20460.

FOR FURTHER INFORMATION CONTACT: Judy E. Hutt, Agency Privacy Act Officer, 1200 Pennsylvania Ave. (2822) Washington, DC 20460; Telephone (202) 260–6131.

SUPPLEMENTARY INFORMATION: This section summarizes the changes to each existing system of records. The summaries focus on alternations in name or function, changes in routine uses, and other major changes. Each summary includes the name of the contact person for the system who provided information for this report.

To the greatest extent possible, the old system numbers have been retained for new systems. Thus, old EPA–1 (Payroll System) remains as EPA–1. In some instances, the system number remains the same even though the name of the system has been updated. Systems number not in current use remain unused under the revisions. There was no old number 6, and there is no new number 6. Numbers for systems proposed for deletion will not be reused. Old number 16, which was used by two existing systems, will not be reused. One old number 16 is obsolete,

TAB E

UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, DC 20207

Memorandum

Date: January 22, 2003

TO : Patricia M. Bittner, M.S., Project Manager,
Directorate for Health Sciences

THROUGH: Hugh McLaurin, Associate Executive Director
Directorate for Engineering Sciences
Mark Kumagai, Acting Division Director
Division of Mechanical Engineering

FROM : Troy W. Whitfield, Mechanical Engineer
Directorate for Engineering Sciences

SUBJECT : Petition HP 01-03 - Petition for Ban on Use of CCA Treated Wood in Playground Equipment – Summary of Related Standards

Background

In June 2001, the CPSC docketed Petition HP 01-03, which asked the Commission to ban the use of chromated copper arsenate (CCA) treated (pressure-treated) wood in playground equipment. Chromated copper arsenate is a pesticide commonly used to treat dimensional lumber (pressure-treated wood) to protect the wood from deterioration and insect infestation. The petitioners assert that arsenic is more carcinogenic than previously known, arsenic is present in significant concentrations on CCA-wood and in underlying soil, the health risks posed by this wood are greater than previously recognized, and past risk assessments were incomplete. The Commission docketed the request for a ban as a petition under the Federal Hazardous Substance Act (FHSA), 15 U.S.C. 1261-1278. The petitioners' request that the Commission review the safety of CCA-treated wood for general use was not docketed as part of the petition since no rulemaking would be involved.

In response to the petition, the CPSC staff began to assess the health risks associated with exposure to CCA pressure-treated lumber. In conjunction with data reviews and exposure studies, the staff is reviewing the existing playground and wood treatment standards. The purpose of this memorandum is to provide the results of the standards review.

Discussion

The staff is unaware of any mandatory standards addressing this issue. Voluntary playground standards have been developed under the auspices of ASTM International (a nonprofit organization devoted to the development of voluntary full consensus standards), and involved manufacturers of playground equipment as well as outside consumer groups, government and other interested parties. The standards are intended to minimize the likelihood of

life-threatening or debilitating injuries by setting safety and performance requirements for various types of playground equipment. The American Wood-Preservers' Association (AWPA) has developed standards for the wood preserving industry under a consensus process in much the same way as the playground standards were developed. The members of the association, representing various areas of interest including; consumers, users, government, researchers, etc., meet to discuss, maintain, and revise the standards as needed.

Playground Standards

There are two nationally recognized voluntary safety standards established to reduce the number of playground associated injuries. Both ASTM F1148-00 and ASTM F1487-01 contain language addressing playground structural materials, including treated wood. The ASTM F1148-00 Standard Consumer Safety Performance Specification for Home Playground Equipment states the following under Section 4. *Performance Requirements*:

> 4.1 *General*—Home playground equipment shall be manufactured and constructed only of materials that have a demonstrated durability in an outdoor setting. Any new materials shall be documented or tested accordingly for durability by the playground equipment manufacturer or their agent.
>
> 4.1.1 Metals subject to structural degradation such as by rust or corrosion shall be painted, galvanized, or otherwise treated. Woods shall be naturally rot- and insect-resistant or treated to avoid such deterioration. Creosote, pentachlorophenol, tributyl tin oxide, and surface coatings that contain pesticides shall not be used for playground equipment. Wood treaters and playground equipment manufacturers shall practice technologies and procedures that minimize the level of dislodgeable toxin. Plastics and other materials that experience ultraviolet (UV) degradation shall be stabilized against ultraviolet light.
>
> 4.1.2 Regardless of the material or the treatment process, the manufacturer shall ensure that the users of the playground equipment cannot ingest, inhale, or absorb any potential hazardous amounts of substances through body surfaces as a result of contact with the equipment.

The second voluntary standard, ASTM F1487-01, Standard Consumer Safety Performance Specification for Playground Equipment for Public Use, Section 4, *Materials and Manufacture* states:

> 4.1 *General Requirements*—Playground equipment shall be manufactured and constructed only of materials that have a demonstrated durability in the playground or similar outdoor setting. Any new materials shall be documented or tested accordingly for durability by the playground equipment manufacturer.
>
> 4.1.1 Metals subject to structural degradation such as rust or corrosion shall be painted, galvanized, or otherwise treated. Woods shall be naturally rot- and insect-resistant or treated to avoid such deterioration. Plastics and other materials that experience ultraviolet (UV) degradation shall be protected against ultraviolet light.

4.1.2 Regardless of the material or the treatment process, the manufacturer shall ensure that the users of the playground equipment cannot ingest, inhale, or absorb any potentially hazardous amounts of substances through body surfaces as a result of contact with the equipment. All paints or other similar finishes shall comply with 16 CFR Part 1303 – Ban of Lead-Containing Paint and Certain Consumer Products Bearing Lead-Containing Paint.

4.1.3 Wood intended for playground equipment that is not naturally rot- and insect-resistant shall be treated to resist rot and insect attack from standard procedures. Any wood not naturally rot- and insect-resistant, which has any fabrication up to 6 in. (150 mm) above, or any portion at or below the level of the protective surface of the playground, shall be treated after wood fabrication. Deviations shall have independent documentation of durability. Creosote, pentachlorophenol, tributyl tin oxide, and surface coatings that contain pesticides shall not be used for playground equipment. Wood treaters and playground equipment manufacturers shall practice technologies and procedures that minimize the level of dislodgeable toxin.

In addition to the ASTM International voluntary standards, the U.S. Consumer Product Safety Commission, "Handbook for Public Playground Safety" (1998) ("Handbook") discusses material requirements. In Section 8, Materials of Manufacture and Construction, the following paragraphs are found:

Wood should either be naturally rot and insect-resistant or treated to avoid such deterioration. The most common wood treatments used in playground equipment are the inorganic arsenicals. Chromated copper arsenate (CCA) is acceptable for use as a treatment of playground equipment wood, if the dislodgeable arsenic (arsenic that might be removable from the wood surface by skin contact or wiping with testing materials) on the surface of the wood is minimized. Inorganic arsenicals should be applied by the manufacturer or wood preserver in accordance with the specifications of the American Wood Preservers Association C17 standard. This standard states that the treated wood should be visibly free of residues which may contain high levels of arsenic (the greenish coloration of CCA treated wood is acceptable). Wood preservers and playground equipment manufacturers should practice technologies and procedures that minimize the level of dislodgeable arsenic. CPSC has found that technology and practices exist to treat playground equipment wood with CCA so that dislodgeable arsenic is below detectable levels.

Installers, builders, and consumers who perform woodworking operations such as sanding, sawing, or sawdust disposal on pressure treated wood should read the consumer information sheet often available at the point of sale. The sheet contains important health precautions and disposal information. Creosote, petachlorophenol, and tributyl tin oxide are too toxic or irritating and should not be used as preservatives for playground equipment wood. Pesticide-containing finishes should also not be used. Other preservatives that have low toxicity and may be suitable for playground equipment wood are copper or zinc naphthenates, and borates.

As a scheduled project in 2003, the CPSC staff will assess the safety recommendations in the Handbook and review the differences between the Handbook and the current ASTM International standard for playgrounds and develop revisions as appropriate. Based on new information, the paragraphs in the CPSC Handbook have been rewritten to state:

> Wood should be either naturally rot and insect resistant (e.g., cedar or redwood) or should be treated to avoid such deterioration. Chromated copper arsenate (CCA), the chemical used to make "pressure" treated wood, has been used traditionally for this purpose. However, CCA will no longer be manufactured for use in wood playground equipment after December 2003. Other chemicals will be substituted for CCA.
>
> The CPSC staff is aware that various groups have made suggestions concerning the application of surface coating of CCA-treated wood, (e.g., stains and sealants), to reduce the potential exposure to arsenic from the wood surface. Based on the available data, these groups have suggested that applying certain penetrating coatings (e.g., oil-based semi-transparent stains) on a regular basis (e.g., every 1-2 years) may reduce the migration of chemicals from the wood. However, in selecting a finish, "film-forming" or non-penetrating stains (latex semi-transparent, latex opaque, and oil-based opaque stains) on outdoor surfaces are not recommended as peeling and flaking may occur later, which will ultimately have an impact on durability as well as exposure to the preservatives in the wood. CPSC has not completed its assessment of the effectiveness of these measures. However, consumers with concerns may wish to consider using them.
>
> Installers, builders, and consumers who perform woodworking operations such as sanding, sawing, or sawdust disposal on pressure treated wood should read the consumer information sheet often available at the point of sale. The sheet contains important health precautions and disposal information. Creosote, petachlorophenol, and tributyl tin oxide are too toxic or irritating and should not be used as preservatives for playground equipment wood. Pesticide-containing finishes should also not be used.

American Wood-Preservers' Association Standards

The AWPA standards describe the various types of preservatives, categories of lumber appropriate for treating, conditioning requirements, and the treatment processes appropriate for preserving wood. There are P-standards (preservatives) that provide specifications for all the AWPA accepted wood preservative and fire retardant treatments. M-standards (miscellaneous) establish quality control routines for the treatment plants. These include visual inspection and boring of treated wood to ensure conformance to the penetration specified for the lumber. The M4 standard stipulates the care of preservative treated wood at the plant, in storage yards and on job sites. Included are recommendations for field fabrication, treatment, and management of used, treated woods. The standard discusses public awareness and the distribution of the Consumer Information Sheets (CIS) or Consumer Safety Information Sheets (CSIS) with the purchase of treated wood products. C-standards (commodities) contain the treatment specifications for various types of lumber and include the processing temperatures and pressures in addition to any pretreatment specifications that may be required to ensure appropriate preservative penetration.

The C-standards are numbered from C1 to C35 with some numbers having been removed due to either lack of use or coverage under another standard. The C1 standard, '*All Timber Products – Preservative Treatment by Pressure Processes*', is considered the master standard and defines the requirements for all the C-standard processes and applies to all species and types of material. The other C-standards (C2-C35) incorporate C1 with either modifications or supplements to the C1 process. There is no specific mention of dimensional lumber in the standards. The definition of 'lumber', as found in the glossary (M5), is material less than 5 inches nominal (prior to finishing) in its least dimension (e.g. 2x4, 2x6, 4x4, etc.). Larger wood, such as a pile, is defined as timber (usually round) embedded in the ground or underwater soil as a support for a larger structure. Fence posts (C5), a subset of poles (C4), cover lengths less than 16 feet and are round, half-round, or quarter round. According to the C5 standard, posts that are sawn on four sides are covered under the C2 *Lumber, Timbers, Bridge Ties and Mine Ties* standard. Some labels, seen on dimensional lumber including posts, identify the C9 *Plywood* standard and the C2 process in treating the wood.

In the February 22, 2002 Federal Register (Vol. 67, No. 36), the EPA announced receipt of requests from registered users of CCA to cancel certain CCA wood preservative products and amend to terminate certain uses of other CCA products. Upon acceptance of the request, the sale, distribution, or use of the affected products will only be permitted if the sale, distribution, or use is within the terms described in the Federal Register notice (docket control number OPP-66300). The notice lists the following acceptable uses (C-standards) for CCA to be effective December 31, 2003: C2 (saltwater use only), C3, C4, C9, C14, C16, C18, C23, C24, C25, C28, C33, and C34. Forest products treated with CCA may only be sold or distributed for the use described by the C-standard under which they were treated. The application of the C2 standard has been qualified for use on lumber and timber intended for saltwater use only. While not listed on the label, the C1 standard is presumed to still be valid since it is the master standard and incorporated into all the above listed standards.

The particular C-standards that have been associated with consumer use materials are listed as follows: C2 – Lumber, Timber, Bridge Ties and Mine Ties, C5 – Fence Posts, C15 – Wood for Commercial-Residential Construction, C17 – Playground Equipment Treated with Inorganic Preservatives, and C22 - Lumber and Plywood for Permanent Wood Foundations. All these preservative treatments are performed under pressure. According to an agreement between EPA and the chemical manufacturers (registrants of the CCA pesticide), these processes will no longer be used with CCA pesticide except for C2 on lumber intended for saltwater use. However, the plywood process (C9) has not been included in this list, yet the process has been listed on dimensional lumber available for consumer purchase.

There is also a standard for wood used on farms. The C16 standard (*Wood Used on Farms*) incorporates the C1 requirements and provides additional specifications for posts, poles, and lumber. There is no information provided on the distribution of this treated wood or how it could be distinguished between consumer and farm use. It appears that dimensional lumber, processed under C16 for farm use, could be available for consumer use depending on the retail sales location. Also, the C24 standard (*Sawn Timber Piles Used for Residential and Commercial Building*) defines sawn timbers as being 5 inches and thicker used as support members in building construction. This seems to indicate that 6"x6" posts (typically used for above

ground/second story deck support and landscaping) can still be processed and would be available for consumer purchase.

Additional Standards

A search was conducted for any international standards pertaining to pressure treated wood. A Canadian standard, several Japanese and Korean standards and some military specifications were identified. The standards deal with wood poles, crossties, materials used in construction; none of the standards identified under 'pressure treated wood' are related to wood used in playgrounds. Additionally, standards located under the 'chromated copper arsenate' search were specifications and test methods for the wood preservative.

Staff is aware that there are actions underway internationally with regard to CCA-treated wood. The Canadian Pest Management Regulatory Agency (PMRA) has reached a voluntary agreement with the wood treatment industry to voluntarily phase out the use of CCA to treat wood. This agreement is similar to that reached with EPA. As part of the Canadian agreement, wood can no longer be treated with CCA for individual uses such as playgrounds, decks, picnic tables, residential fencing, etc. after December 31, 2003. Remaining stocks of wood treated prior to that date can still be sold in stores and can be used for residential construction in Canada. Previously built structures are not affected.

The European Commission is currently considering a proposal to ban the marketing and use of arsenic wood paints and arsenic treated wood (personal communication from T. Daskaleros 2002). There are likely to be exemptions for certain applications of CCA-treated wood. It is anticipated that the regulatory process will take several months (personal communication from T. Daskaleros 2002).

Summary

The ASTM referenced documents are nationally recognized and may need to be revised to reflect the petitioners' request to ban the use of CCA wood in the construction of playground structures if the petition is granted.

The ASTM subcommittees for both Home and Public Playground Equipment are awaiting the results of the CPSC staff study and/or recommendations before determining whether revisions will be made to the existing standards. As currently written, there is no specific reference to CCA-treated wood and the phrase "surface coatings that contain pesticides shall not be used for playground equipment" is already stated in both the home and public playground standards. While CCA is not a surface coating, there is language that may already address the issue. Both the public and home playground standards state that "[r]egardless of the material or the treatment process, the manufacturer shall ensure that the users of the playground equipment cannot ingest, inhale, or absorb any potential[ly] hazardous amounts of substances through body surfaces as a result of contact with the equipment." Depending on the CPSC staff findings, the current language may be adequate to address CCA-related issues with home and public playgrounds. However, with some home playgrounds, the consumer may purchase the wood as part of a kit at a local lumberyard where CCA (pressure-treated) wood is currently available.

According to the EPA's Federal Register notice and supplemental information provided, CCA pesticide is not to be used to pressure treat wood for most consumer uses on and after December 31, 2003. The following AWPA C-standard processes are effected: C2-Lumber, Timber, Bridge Ties and Mine Ties (except for saltwater use), C5-Fence posts, C15-Wood for Commercial /Residential Construction, C17-Playground Equipment Treated with Inorganic Preservatives, and C22-Lumber and Plywood for Permanent Wood Foundations. According to labeling seen on some dimensional lumber available for consumer purchase, the wood has been processed under both the C2 and C9 specifications. It may be that lumber labeled with both the C2 and C9 standard meets either or both specifications, but for ease in labeling, is marked with a single label acknowledging both processes.

References

ASTM F1148-00 Standard Consumer Safety Performance Specification for Home Playground Equipment, 2000

ASTM F1487-01 Standard Consumer Safety Performance Specification for Playground Equipment for Public Use, 2001

American Wood-Preservers' Association Standards – 2001

Environmental Protection Agency Federal Register/Vol. 67, No. 36/ Friday, February 22, 2002/ Notices OPP-66300; FRL-6826-8

Daskaleros T. 2002. Personal communications from T. Daskaleros, Principal Administrator, Unit B.3 (Product and Service Safety), Health and Consumer Protection Directorate General of the European Commission to Michael Babich, Chemist, and Patricia Bittner, U.S. Consumer Product Safety Commission. December.

TAB F

UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, DC 20207

Memorandum

Date: 23 January 2003

TO : Patricia M. Bittner, M.S., Project Manager, CCA-Treated Wood in Playground Equipment, Directorate for Health Sciences

THROUGH: Mary Ann Danello, Ph.D., Associate Executive Director, Directorate for Health Sciences MAD
Lori E. Saltzman, M.S., Division Director, Directorate for Health Sciences LS

FROM : Kristina M. Hatlelid, Ph.D., Toxicologist, Directorate for Health Sciences KH

SUBJECT : Toxicity Review for Arsenic

Introduction

In May 2001, the U.S. Consumer Product Safety Commission (CPSC) was petitioned by the Environmental Working Group (EWG) and the Healthy Building Network (HBN) to enact a ban of CCA-treated wood for use in playground equipment and to review the safety of CCA-treated wood for general use. In June 2001, the CPSC docketed the part of the petition that requested a ban on the use of CCA-treated wood in playground equipment (66 FR 36756). The petition was docketed under provisions of the Federal Hazardous Substances Act (FHSA) 15 U.S.C. 1261-78. The second part of the petition, to review the safety of CCA wood for other uses, was not docketed as a petition for rulemaking because it would not require rulemaking to implement. Docketing is the initial step in Commission consideration of what action, if any, to take in response to the assertions in the petition.

Chromated copper arsenate (CCA) is composed of oxides of chromium, copper, and arsenic. In considering the petition, the CPSC staff have reviewed the constituents (chromium, copper, and arsenic) of CCA. This memorandum contains the toxicity review for arsenic.

Arsenic is the subject of a 2000 Toxicological Profile by the Agency for Toxic Substances and Disease Registry (ATSDR, 2000) and the human carcinogenic risk of arsenic and arsenic compounds was reviewed in an International Agency for Research on Cancer (IARC) monograph and update (IARC, 1980; IARC, 1987). The National Research Council (NRC) considered arsenic in drinking water in two reports (NRC, 1999; NRC, 2001). Other sources of data include the Hazardous Substances Data Bank (HSDB, 1988) and the Integrated Risk Information System (IRIS) of the U.S. Environmental Protection Agency (EPA, 1998). Since comprehensive reviews have been conducted by these august bodies, much of the information in this review has been drawn from these works. In this report, all doses and exposures are expressed in terms of arsenic.

Occurrence

Arsenic is found naturally in the environment in a variety of chemical forms. Arsenic compounds are usually separated into inorganic and organic forms. Arsenic compounds may also be categorized by the oxidation state of the arsenic. Although arsenic may exist in any of four oxidation states, As(-III), As(0), As(III), and As(V), the As(III) (also written as As^{+3}) and As(V) (also written as As^{+5}) oxidation states are the most environmentally stable forms.

As summarized by ATSDR (2000), arsenic is found in the earth's crust at an average concentration of about 2 micrograms of arsenic per gram (μg/g). It is primarily found in igneous and sedimentary rocks as inorganic compounds, most abundantly in sulfide ores, such as arsenopyrite (FeAsS). Arsenic may be released into the environment from natural sources (*e.g.*, wind-blown soil and volcanoes), but human activities are a much larger source. Anthropogenic sources include nonferrous metal mining and smelting, pesticides, combustion of coal and wood, and waste incineration.

Inorganic arsenic compounds, including calcium arsenate and lead arsenate, are no longer used in agriculture, but organic arsenicals, such as disodium methylarsenate (DMSA), dimethylarsinic acid (DMA) and sodium methanearsonate (MSMA), are still in use, primarily on cotton. Arsanilic acid (*p*-aminophenylarsonic acid) and roxarsone (4-hydroxy-3-nitrophenylarsonic acid) have been used as feed additives for poultry and swine. The inorganic compound sodium arsenite has been used in cattle and sheep dip. Inorganic arsenic may also be used in ant bait.

Both inorganic and organic arsenicals have been used in medicine. While most uses have been discontinued, melarsoprol (see Table II in Appendix A) may be used to treat trypanosomiasis (parasitic protozoan infection), and arsenic trioxide is indicated for the treatment of acute promyelocytic leukemia.

Physical and chemical properties of selected inorganic and organic arsenic compounds are presented in Table I (inorganic) and Table II (organic) of Appendix A.

Chromated copper arsenate (CCA) is a mixture of chromic oxide, cupric oxide, and arsenic pentoxide. About 90 percent of the U.S. consumption of arsenic is in CCA treatment of wood (ATSDR, 2000). Little data is available on the chemical and physical characteristics of arsenic compounds that result from treatment of wood with CCA. Studies have shown, however, that arsenic compounds may leach out of treated wood, and may be removed from the surface of the wood by wiping or rubbing (CDHS, 1987; Jain, 1990; Lebow, 1996; Cobb, 2003). These data also suggest that the arsenic in treated wood or in the residue removed from the surface is somewhat soluble in water, and that solubility increases under acidic conditions.

Environmental levels of arsenic are often reported in terms of the inorganic forms, arsenate [As(V) or As^{+5}] and arsenite [As(III) or As^{+3}], and the organic "methylated" compounds, DMA and monomethylarsonic acid (MMA). Arsenate and arsenite exist as oxyanions in oxidized environments, with the degree of protonation dependent on pH. Metallic arsenic [As(0)], arsine (-III), and methylated forms are thermodynamically stable in reducing environments, such as swamps.

Air

Airborne arsenic levels, generally in the form of particulate arsenate and arsenite, range from less than one to three nanograms of arsenic per cubic meter of air (<1-3 ng/m^3) in rural areas to 20-30 ng/m^3 in urban areas. Emissions from coal-fired power plants account for the greater air concentrations in urban areas. Air levels of organic species are negligible except in areas of methylated arsenical pesticide use (ATSDR, 2000).

Water

Arsenic concentrations in surface, ground, and finished drinking water supplies vary greatly across the U.S. and worldwide. Sources of arsenic in water are natural arsenic mineral deposits, including volcanic deposits; anthropogenic sources, such as mining and smelting; and pesticide/herbicide use. Although most values are below 10 micrograms of arsenic per liter of water (10 µg/L or 10 ppb), with mean levels around 1-2 µg/L (ATSDR, 2000), arsenic levels in groundwater have approached 50,000 µg/L in western U.S. mining areas (Welch *et al.*, 1988). A survey of U.S. drinking water sources found less than five percent of finished surface and ground water exceeded 10 µg/L (Frey and Edwards, 1997). Arsenic in rainwater has been reported at average concentrations of 0.2-0.5 µg/L (Welch *et al.*, 1988).

Soil

As with water, soil arsenic concentrations vary greatly across the U.S. and worldwide, and are related largely to natural arsenic mineral deposits, including volcanic deposits; anthropogenic sources, such as mining and smelting; and pesticide/herbicide use. Background soil arsenic levels range from about 1 to 40 µg/g (ppm), with a mean of about 5 µg/g. Levels in areas of agricultural arsenical use have been measured at about 20-140 µg/g, compared to about 2 µg/g in

nonagricultural control soil samples. Mining and smelting activities have resulted in levels greater than 50,000 µg/g in some cases (ATSDR, 2000).

Several studies have measured arsenic soil levels near CCA treated wood structures (reviewed by Lebow, 1996). A recent study (Stilwell and Gorny, 1997) found that soil beneath residential decks constructed from CCA treated wood contained an average 76 µg/g, compared to nearby control samples (background) averaging 3.7 µg/g. Another study shoed that soil arsenic levels near wooden highway traffic sound barriers averaged 67 µg/g with background levels of 1.4 µg/g (Stilwell and Graetz, 2001).

Food

Arsenic is common in food at low concentrations— generally less than 0.03 µg/g. The highest concentrations are found in seafood and seaweed, at about 4-5 µg/g. Other foods with greater than average arsenic concentrations are meat and poultry, and grains and cereals (ATSDR, 2000). Most of the arsenic in food is present in relatively nontoxic organic forms, such as arsenobetaine, although studies have shown that the proportion of inorganic arsenic ranges from 0.1 to 41 percent (Vaesson and van Ooik, 1989), and can be considerably higher in areas with elevated water arsenic levels (Schoof *et al.*, 1998). Schoof *et al.* (1999) estimated the mean intake of inorganic arsenic from the diet in the U.S. as 3.2 µg/day.

Exposure

Food generally accounts for the largest source of daily exposure for inorganic arsenic and total arsenic, followed by soil (for children), water, and air. Average daily intake of inorganic arsenic is 0.1-2.6 µg/kg-body weight (ATSDR, 2000). This is equivalent to daily intake of about 2-46 µg for a small child or about 7-180 µg for a 70-kg adult.

LD_{50}s and Systemic Effects

The Toxicological Profile for Arsenic by the Agency for Toxic Substances and Disease Registry (ATSDR, 2000) reviews dozens of studies and reports of effects of arsenicals in animals and humans. Key findings are summarized here.

Inorganic arsenicals

Acute exposures by ingestion to high doses of inorganic arsenic in humans have caused vomiting, diarrhea, abdominal pain, and gastrointestinal hemorrhage; liver and kidney function changes; hypotension, tachycardia, pulmonary edema, and difficulty breathing at doses from 0.05 milligrams arsenic per kilogram body weight per day (mg/kg/day) (equivalent to 50 µg/kg/day) for single or multiple exposures (Franzblau and Lilis, 1989; and others). Neurological effects, as well as dermal and ocular effects have been noted (discussed below). Death may occur from fluid loss, circulatory collapse, and damage to multiple organ systems. Lethal doses in single exposures have been estimated at 22-121 mg/kg (Levin-Scherz *et al.*, 1987; Civantos *et al.*, 1995; and others); two deaths were reported after one week of exposure to about 2 mg/kg/day (Armstrong *et al.*, 1984). These toxic effects have been reported for arsenic in both the As^{+3} and As^{+5} forms, although the trivalent arsenic compounds (As^{+3}) tend to more toxic than the pentavalent forms (As^{+5}). In cases of environmental inorganic arsenic exposure, such as through drinking water, arsenic levels are generally reported as total inorganic arsenic. However, the arsenic may be present as As^{+3}, As^{+5}, or a mixture of both forms.

Chronic exposure in humans is associated with a variety of effects, such as weight loss, and gastrointestinal, hepatic, and hematological effects, but dermal and cardiovascular (including Blackfoot disease) effects become characteristic of long-term exposure to drinking water at doses from about 0.002 mg/kg/day. Long-term exposure (lifetime) to 0.05 mg/kg/day was associated with the deaths of five 2- to 7-year-old children in one case report (Zaldivar and Gullier, 1977), and a 22-year-old man died after consuming about 0.014 mg/kg/day (Zaldivar *et al.*, 1981).

One large study of drinking water exposure did not detect any effects at 0.0008 mg/kg/day (Tseng *et al.*, 1968). This study is the basis of the IRIS oral reference dose (RfD). The RfD is based on the assumption that a threshold exists for certain toxic effects. It is an estimate of daily exposure that is likely to be without appreciable risk of deleterious noncarcinogenic effects during a lifetime. Using 0.0008 mg/kg/day as the NOAEL (no observed adverse effect level), and applying an uncertainty factor of 3[1] results in an RfD of 0.0003 mg/kg/day (EPA, 1998).

Effects of acute inorganic arsenic exposure in experimental animals include gastrointestinal effects, such as vomiting, observed in monkeys, and diarrhea and bloody stools, observed in rats; as well as liver and bone marrow effects in rats and mice at doses as low as 0.9 mg/kg/day. LD_{50} values range from 15 to 175 mg/kg (Harrison *et al.*, 1958; Gaines, 1960; and others). Chronic effects in experimental animals include liver, kidney, and hematological effects; decreased body weight gain; and decreased life span at doses from 1 mg/kg/day (Schroeder and Balassa, 1967; and others).

Organic arsenicals

Acute ingestion of dimethylarsinic acid (DMA) in humans resulted in sinus tachycardia, and gastrointestinal effects, including vomiting, abdominal pain, and diarrhea at 77 mg/kg (Lee *et al.*, 1995). Ingestion of MSMA at 793 mg/kg caused vomiting (Shum *et al.*, 1995). No deaths or chronic exposures to organic arsenical in humans have been reported.

Several studies of DMA, MMA, and roxarsone (see Table II in Appendix A) in dogs, rats, mice, and rabbits showed LD_{50} values ranging from 14.2 mg/kg in dogs given roxarsone to 963 mg/kg in mice administered MMA (Kerr *et al.*, 1963; Kaise *et al.*, 1989; and others). Systemic effects included gastrointestinal, liver, kidney, and hematological effects.

Subchronic studies of DMA, MMA, and roxarsone in animals showed decreased body weight, liver, kidney, gastrointestinal, and neurological effects at doses from 0.87 mg/kg/day (Kennedy *et al.*, 1986; and others). Decreased survival was noted at doses as low as 5.7 mg/kg/day (Kerr *et al.*, 1963; Edmonds and Baker, 1986; and others). A lifetime study of roxarsone in rats and mice showed only decreased body weight in female mice at 4.8 mg/kg/day (NTP, 1989). No other effects in mice were noted at 9.7 mg/kg/day or in rats at 2.3 mg/kg/day.

Dermal and Ocular Effects

Inorganic arsenicals

Acute ingestion exposure in humans to inorganic arsenic was associated with dermal (rash) and ocular (periorbital swelling, constricted vision, facial edema) effects in a few cases. Repeated or long-term exposures are associated with characteristic skin lesions that include hyperkeratosis on

[1] The uncertainty factor was used to account for the uncertainty in whether the NOAEL accounts for all sensitive individuals, and to account for lack of data on reproductive toxicity as a critical effect in the studied population.

the palms of the hands and soles of the feet; and hyperpigmentation with small areas of hypopigmentation on face, hands, and back at doses as low as 0.005 mg/kg/day (Lianfang and Jianzhong, 1994; and others). These effects appear to be the most sensitive indication of exposure in cases of chronic, low-dose exposures. As discussed above, a large study did not detect any effects at a total intake of 0.0008 mg/kg/day (Tseng *et al.*, 1968).

The characteristic dermal effects of ingested inorganic arsenic have not been observed in monkeys, dogs, or rodents.

Exposure to arsenic in the air, such as in factories and smelters, has caused dermatitis, characterized by hyperpigmentation, hyperkeratinization, folliculitis, and ulcerations, at levels as low as about 0.007 mg/m^3 (Mohamed, 1998; and others). Chemical conjunctivitis, with redness, swelling, and pain has also been reported, usually in conjunction with facial dermatitis (Dunlap, 1921; Pinto and McGill, 1953).

In mice, direct application to the skin of 4 mg/kg/day as potassium arsenite, caused dermal irritation (Boutwell, 1963). No significant irritation was observed in guinea pigs exposed to aqueous solutions of arsenate (4,000 mg/L) or arsenite (580 mg/L) (Wahlberg and Boman, 1986).

Organic arsenicals

No reports were found for dermal or ocular effects of oral exposure to organic arsenicals in humans or experimental animals.

Airborne organic arsenic appeared to be associated with increased incidence of keratosis in one worker population (Watrous and McCaughey, 1945).

Exposure to high levels of DMA dust in the air caused erythematous lesions of the feet and ears in female rats and encrustation around the eyes of mice and rats (Stevens *et al.*, 1979). MMA applied to skin of rabbits resulted in mild dermal irritation (Jaghabir *et al.*, 1988).

Reproductive/Developmental Effects

Inorganic arsenicals

Several epidemiologic studies have suggested that exposure to relatively high levels of arsenic in drinking water may be associated with adverse pregnancy outcomes, such as spontaneous abortion, stillbirth, preterm birth, and infant mortality.

A series of reports of occupational and residential exposure to smelters document arsenic exposure and rates of spontaneous abortions, low birthweight, or malformations (reviewed by DeSesso *et al.*, 1998, and Shalat *et al.*, 1996). Although some associations were seen between arsenic exposure and adverse outcomes, confounding from other risk factors, such as maternal smoking and age, or from other chemicals found in or near the smelters cannot be ruled out.

One study specifically evaluated a cluster of neural tube defects in a Texas community (TDH, 1992; as cited by DeSesso *et al.*, 1998, and Shalat *et al.*, 1996). However, no measure of exposure, including maternal urinary arsenic levels, was associated with the outcome.

In an ecological study, Hopenhayn-Rich *et al.* (2000) found that increased incidence of fetal and infant mortality in one region of Chile was associated with very high levels of arsenic in the public drinking water (860 µg/L) with respect to a comparison region with low levels of arsenic

(<5 μg/L). As an ecological study, which is not based on individual data on exposure, outcomes, or confounders, this study does not establish a clear causal association. However, the data are suggestive of a link between arsenic exposure and infant mortality.

Ahmad *et al.* (2001) performed a cross-sectional study of two regions of Bangladesh. Drinking water in one region had relatively high levels of arsenic (mean, 240 μg/L). Water in the comparison region was 20 μg/L or less. In contrast to the ecological study, data on pregnancy outcomes were collected from individual women. Most of the women in the exposed group had been drinking water containing >100 μg/L arsenic for at least 5 years, and 23 percent of women in the exposed group had skin manifestations of arsenic toxicity. A statistically significant increased rate of adverse pregnancy outcomes was observed in women in the exposed group compared to the unexposed group. In addition, exposure to high levels of arsenic in the drinking water for more than 15 years was associated with increased rates of adverse outcomes compared to women exposed for less than 15 years.

Numerous studies in experimental animals (reviewed by DeSesso *et al.*, 1998, and Shalat *et al.*, 1996) have found that arsenic exposure early in gestation causes neural tube defects in hamsters, rats, and mice, while exposure later in gestation causes other malformations and embryonic death. In general, adverse effects have been observed after parenteral (intravenous or intraperitoneal) administration of relatively high doses of arsenic (>1 mg/kg). Oral administration of doses that caused severe maternal toxicity and death (up to 48 mg/kg) caused increased resorptions and decreased fetal weights, but did not result in increased incidence of fetal malformations.

Recent work showed that reduced fetal body weight and increased incidence of skeletal variations occurred with daily oral dosing of 8 mg/kg starting 14 days prior to mating; no developmental effects were seen at 4 mg/kg/day (Holson *et al.*, 2000). Nemec *et al.* (1998) found rabbits to be more sensitive than other experimental animal species. Increased resorptions and decreased viable fetuses per litter occurred at maternally toxic oral doses of 1.5 mg/kg/day. In this study, the developmental and maternal toxicity NOAEL was 0.4 mg/kg/day.

There is limited data supporting a link between arsenic exposure and reproductive or developmental effects in humans. In animals, developmental effects have been observed with parenteral dosing of arsenic. Very high oral doses, resulting in maternal toxicity and death, cause reduced fetal body weight and fetal death, but few malformations.

Organic arsenicals

No studies on developmental effects of organic arsenicals in humans were found. In experimental animals, limited data suggest that, as with inorganic arsenicals, organic arsenic compounds are associated with some developmental effects at very high, maternally toxic doses (DeSesso *et al.*, 1998).

Neurological Effects

Inorganic arsenicals

Encephalopathy, peripheral neuropathy, confusion, lethargy, seizures, and coma have been observed in cases of acute, high-dose exposures in humans (above 2 mg/kg/day) (Armstrong *et al.*, 1984). Although the peripheral neuropathy has been reported following acute exposures, it is more typical of longer term, lower dose exposures. This neuropathy is described as numbness in

hands and feet, progressing to painful "pins and needles" sensations. Sensory and motor neurons are affected, characterized by dying back axonopathy with demyelination. Neurological effects have not generally been observed with chronic exposure to less than 0.005 mg/kg/day (Lianfang and Jianzhong, 1994).

Some neurological effects have been reported in experimental animals. Monkeys demonstrated excessive salivation and head shaking after administration of 6 mg/kg/day for 2 weeks (Heywood and Sortwell, 1979) and pregnant rabbits experienced ataxia and prostration after administration of 1.5 mg/kg/day during gestation (Nemec *et al.*, 1998).

Organic arsenicals

One case of ingestion of organic arsenic (form and dose not specified) in a woman resulted in numbness and tingling of fingers, toes, and mouth area (Luong and Nguyen, 1999).

Repeated dosing of pigs with roxarsone caused severe neurological effects, including muscle tremors, partial paralysis, seizures, and myelin degeneration, at doses from 0.87 mg/kg/day (Kennedy *et al.*, 1986; and others). In rats exposed to 11.4 mg/kg/day, roxarsone caused comparatively less severe neurological effects, including hyperexcitablity, ataxia, and trembling (NTP, 1989).

Carcinogenicity and Genotoxicity

A large body of literature exists on genotoxicity and carcinogenicity, both experimental studies *in vitro* and *in vivo*, and observational epidemiology studies in several populations. A number of reviews discuss the available data including the Toxicological Profile for Arsenic (ATSDR, 2000), International Agency for Research on Cancer monograph and update (IARC, 1980; IARC, 1987), the National Research Council reports on arsenic in drinking water (NRC, 1999; NRC, 2001), and the Integrated Risk Information System (EPA, 1998). Some key findings are discussed here.

Inorganic arsenicals

A characteristic effect of arsenic exposure in humans is skin cancer. The association between skin cancer and arsenic exposure through ingestion of drinking water or medicinal use of Fowler's solution (potassium arsenite) has been shown in a number of populations. Skin cancers are usually multiple squamous cell carcinomas that appear to develop from the hyperkeratotic lesions induced by chronic arsenic exposure, but basal cell carcinomas are also observed that are not associated with keratinization.

A few studies have linked inhalation exposure with lung cancer in smelter workers, pesticide manufacturers and applicators, and residents near pesticide manufacturing, although exposure to other chemicals in these situations may have been responsible for the observed effect. More recently, exposure to arsenic in drinking water has been shown to be associated with internal cancers, including liver, lung, bladder, kidney, and prostate. The precise chemical forms of inorganic arsenic in these studies is not known; assessments of exposure and related effects, including those summarized here, generally consider the total exposure to arsenic.

Key data on skin cancer and drinking water in southwestern Taiwan are published in Tseng *et al.* (1968) and Tseng (1977). Tseng and coworkers studied a population in an area of southwest Taiwan that began using artesian wells containing up to 1,820 ppb arsenic (1,820 µg/L) about 1910. Most of the wells contained 400-600 ppb arsenic. In the 1960s, more than 40,000 residents

in the region were examined for hyperpigmentation, keratosis, and skin cancer. The authors observed a dose-related increase in both noncancer effects and skin cancer prevalence.

More recently, the association between arsenic exposure from drinking water and mortality from skin cancer and internal cancers (*e.g.*, liver, lung, and bladder cancers) in the same region of southwest Taiwan was described by Chen *et al.* (1985), Chen *et al.* (1986), Chen *et al.* (1988), Wu *et al.* (1989), Chen and Wang (1990), and Chen *et al.* (1992). These researchers used death certificate data from the affected villages to assess cancer mortality. A dose-related increase was observed for skin, bladder, kidney, liver, lung, and prostate cancers.

Studies in other populations support the association between arsenic ingestion from drinking water and skin and internal cancers. For example, in a study of a cohort of more than 8,000 residents in northeastern Taiwan, Chiou *et al.* (2001) reported a significant dose-response relationship between the incidence of bladder and kidney cancer and drinking water containing arsenic at concentrations greater than 100 ppb compared to water with 10 ppb arsenic or less, after adjusting for age, sex, and cigarette smoking.

A case-control study in northern Chile included a region with average drinking water arsenic levels up to 860 ppb (Ferreccio *et al.*, 2000). Cases were 151 lung cancer patients, and controls were 419 frequency-matched hospital patients. The results of logistic regression analysis indicate a significant dose-response relationship between lung cancer and drinking water with arsenic concentrations ranging from less than 10 ppb to an average concentration of 200-400 ppb. The data also suggest a synergistic interaction between arsenic ingestion and cigarette smoking. Hopenhayn-Rich *et al.* (1998) report results from an ecological study in Argentina that also suggest that arsenic ingestion increases the risk of mortality from lung and kidney cancers, although the association with liver and skin cancers was not clear. In this study, the average drinking water arsenic level in the highest exposure group was 178 ppb.

Considerable debate exists about the relevance of data from other parts of the world, especially Taiwan, to the U.S. Critics charge that these largely rural populations may have genetic or nutritional susceptibilities to cancer that are not found in the U.S., and that the arsenic exposures in these countries are so high compared to the U.S. that they cannot be used to develop dose-response models appropriate for the lower U.S. exposures (Carlson-Lynch *et al.*, 1994; Rudel *et al.*, 1996; Stöhrer, 2001). On the other hand, EPA (2001), NRC (2001) and others (Smith *et al.*, 1992; Steinmaus *et al.*, 2000) argue that despite the weaknesses in the epidemiology studies and the uncertainties about extrapolating to the U.S. population, there is no evidence that the Taiwanese or South American populations are particularly susceptible to the toxic or carcinogenic effects of arsenic compared to U.S. populations. Although the population of southwest Taiwan is rural and poor, and consumes a diet dependent largely on sweet potatoes and rice, other populations with increased cancer mortality associated with arsenic in drinking water (Chile, Argentina, and northeast Taiwan) have no discernible nutritional deficiencies compared to the U.S. Thus, there is no convincing evidence that arsenic does not cause cancer at relatively low exposures. Further, there are no data that suggest that low-dose risk should not be extrapolated from the high-dose exposures in the Taiwanese or South American populations.

On the other hand, several epidemiological studies in the U.S. have not detected increased cancer incidence in populations with elevated arsenic drinking water levels (up to about 200 ppb) (Morton *et al.*, 1976; Lewis *et al.*, 1999). These studies of relatively small populations did not have sufficient statistical power to detect the small increases in cancer incidence that would be

expected at the relatively low doses experienced by the U.S. populations. In addition, the study by Lewis *et al.* (1999) of a Utah cohort shows that the exposed cohort had a significantly lower incidence of cancers compared to the statewide Utah population, which suggests that the cohort differed from the larger population in important ways. For example, the cohort was rural and belonged to a religion with strict lifestyle rules, while the larger Utah population includes several urban centers and represents a variety of religious and cultural backgrounds. In addition, the NRC (2001) concluded that an increased incidence of cancer due to the generally low arsenic exposures in the U.S. would be difficult to detect over the relatively high background rates of cancer in this country.

Thus, the CPSC staff believes that, despite the lack of data on arsenic-related cancers in the U.S., the cancer risk determined in other countries with relatively high arsenic exposures may be used to estimate arsenic-associated cancer risks in the U.S.

IARC classifies arsenic and arsenic compounds as Group 1, carcinogenic to humans, based on sufficient evidence for lung and skin carcinogenicity in humans from oral and inhalation exposure (IARC, 1987). Although IARC reviewed data on the association between arsenic ingestion and internal cancers, such as liver cancer, the data were said to be inadequate for evaluation. In IRIS, the EPA classified inorganic arsenic as group A, a human carcinogen, based on skin, lung and other internal cancers (EPA, 1998). EPA calculated unit risks for skin cancer from the oral route of exposure (0.0015 per μg/kg/day) and for lung cancer from the inhalation route (0.0043 per $\mu g/m^3$).

Despite the strength of the evidence in humans, most animal models have been negative for arsenic-induced cancers (ATSDR, 2000; IARC, 1987; NRC, 1999, 2001). However, recent efforts indicate tumorigenic and proliferative effects in some animal models (NRC, 2001), as well as co-carcinogenic effects (Rossman *et al.*, 2001).

Results of *in vivo* and *in vitro* genotoxicity studies are equivocal (reviewed by Pott *et al.*, 2001; NRC, 2001). Most studies indicate that arsenic compounds are inactive or weakly mutagenic, although growing evidence suggests arsenic may be comutagenic (*i.e.*, arsenic may enhance the effects of known mutagens, such as ultraviolet radiation). In addition, chromosomal effects, such as sister chromatid exchange and chromosomal aberrations, are observed in most systems. A number of specific biological effects of arsenic have been observed *in vitro* that suggest that arsenic could act to promote or enhance carcinogenic activity of other agents. These effects include induction of oxidative DNA damage; altered DNA methylation and gene expression; inhibition of enzymes involved in cellular energy production, DNA repair, and other stress-response pathways; altered function of the glucocorticoid receptor; and other effects concerning signal transduction, cell-cycle control, differentiation, cytotoxicity, and apoptosis. Many of these effects could be involved in arsenic-related carcinogenesis, although the induction of apoptosis could act to prevent cancer. Arsenic-induced apoptosis has been suggested to have an important role in the treatment of acute promyelocytic leukemia (NRC, 2001). Although the ability of arsenic to cause such effects in humans or the whole animal cannot be predicted from *in vitro* studies, these results do provide evidence of possible carcinogenic mechanisms and anticarcinogenic modes of action.

Organic arsenicals

No studies were found on the carcinogenicity of organic arsenicals in humans. Several studies in animals (reviewed by ATSDR, 2000; NRC, 2001) suggest that DMA and roxarsone act as tumor

promoters and may be weakly carcinogenic. Several studies also indicate that DMA and roxarsone may cause chromosome aberrations, mutations, and DNA strand breaks.

Other effects

Exposure to arsenic in drinking water has been associated with increased incidence of diabetes mellitus and hypertension in Bangladesh (Rahman *et al.*, 1998; Rahman *et al.*, 1999) and Taiwan (Chen *et al.*, 1995; Tseng *et al.*, 2000). An *in vitro* study using hormone-responsive rat hepatoma cells found that arsenic interacts with glucocorticoid receptor complexes and selectively inhibits glucocorticoid receptor-mediated transcription through altered nuclear function (Kaltreider *et al.*, 2001). The authors suggest that these findings may indicate a role for arsenic in disrupting glucose homeostasis in the liver and other organs, as well as a mechanism for arsenic carcinogenicity.

Mechanisms of Toxicity

Arsenic cytotoxicity may occur through disruptions in cellular production of energy. Arsenite reacts with sulfhydryl groups of proteins causing enzymatic inactivation and arsenate can substitute for phosphate in energy-producing reactions. Arsenic may also uncouple oxidative phosphorylation. The effect of these reactions is a reduction in cellular ATP levels with widespread effects on cellular functions.

The mechanisms responsible for arsenic's carcinogenicity have not been elucidated. *In vivo* and *in vitro* work has identified a number of cellular effects of arsenic that could result in promoting or enhancing carcinogenicity.

Pharmacokinetics

Absorption

Soluble forms of inorganic arsenic are generally well absorbed after oral exposure in both humans and experimental animals. Studies in humans indicate absorption of 55-95 percent of oral doses of arsenite and arsenate (Buchet *et al.*, 1981; and others). Inorganic arsenic species are also well absorbed by mice and monkeys, but rats and rabbits appear to absorb less (Hughes *et al.*, 1994; Gonzalez *et al.*, 1995a; Freeman *et al.*, 1993; and others). Absorption of insoluble forms, such as arsenic trisulfide and lead arsenate, is generally reduced (Marafante and Vahter, 1987). Several studies indicated that dosing in soil or dust matrices results in reduced bioavailability relative to soluble forms administered in aqueous solution (*i.e.*, relative bioavailability) (reviewed by ATSDR, 2000). Although relative bioavailability ranged from 0 to 98 percent, most values were less than 50 percent. The wide range of absorption values likely is due to many factors, including the animal species, arsenic species, soil or matrix characteristics, and dosing regimen.

A few studies of the bioavailability of arsenic from CCA-treated wood or soils impacted by CCA chemicals have been conducted, although only one has been subject to peer review and published (Roberts *et al.*, 2002). The others have been variously reviewed or discussed by the EPA's Scientific Advisory Panel (SAP, 2001) or on behalf of the wood treatment industry (Exponent, 2001; Gradient Corporation, 2001). In general, these studies indicate that the bioavailability of arsenic from soil or wood is reduced relative to arsenic in solution. Although the range of values is wide, they are consistent with other published studies of arsenic in soil or other matrices.

The EPA Scientific Advisory Panel considered the available data for the purposes of conducting risk assessments. The panel expressed concern that the high dose, bolus administration of arsenic-containing soils used in these studies does not reasonably simulate the anticipated low-dose, repeated exposures in children. The panel was likewise concerned with the relatively high levels of arsenic in the test soils. Based on questions about the limited data on bioavailability of arsenic from soils, and the lack of data about arsenic-containing surface residue, the panel recommended that 100 percent relative bioavailability be used in risk assessment until appropriate research is conducted.

The organic species, MMA and DMA, are also well absorbed following ingestion in human volunteers and experimental animals (Marafante *et al.*, 1987; and others).

Few studies on dermal absorption of arsenicals have been reported. Wester *et al.* (1993) conducted several experiments on dermal absorption of arsenic from water and soil. Arsenic-73 radiolabeled arsenic acid (As^{+5}), mixed in water or soil, was applied to the abdomens of Rhesus monkeys for 24 hours. Absorption from water was approximately 2-6 percent, while 3-5 percent of the soil dose was absorbed. A 24-hour *in vitro* study of percutaneous absorption by human skin resulted in about two percent of the dose in water accumulating in the receptor fluid or remaining in the skin after washing. Less than one percent of the soil dose was found in the receptor fluid or skin. In both the *in vivo* and *in vitro* experiments, soap and water easily removed residual arsenic from the skin surface. The limited data indicate that dermal uptake of soluble arsenic can occur from contact with aqueous solutions or arsenic-treated soil.

Distribution

In humans, inorganic arsenic is distributed throughout the body and appears in hair and nails (reviewed by ATSDR, 2000). Following acute ingestion, higher levels are found in liver than in other tissues. Inorganic arsenic passes through the placenta and appears in breast milk. Distribution of inorganic arsenic in animals is similar.

No studies were found on the distribution of organic arsenic compounds in humans. In animals, MMA and DMA are found in all tissues following oral exposure. In rats, DMA is retained in the erythrocyte, resulting in a tissue distribution pattern that is different from other species.

Metabolism

The metabolism of inorganic arsenic species has been well studied in humans and experimental animals, and is reviewed by ATSDR (2000) and NRC (2001). Two processes are involved in metabolism of inorganic arsenic. Oxidation/reduction reactions interconvert arsenite (As^{+3}) and arsenate (As^{+5}), and methylation reactions produce MMA and DMA. Reactions with molecules such as glutathione may be involved in directly reducing arsenate to arsenite, or reduction may occur enzymatically. Methylation is enzymatic with S-adenosylmethionine as the cosubstrate. It occurs primarily in the liver. The availability of methyl donors, such as methionine, choline, and cysteine, does not appear to be rate limiting, but severe dietary restriction of methyl donor intake can result in decreases in methylating capacity. Arsenite is the substrate for the arsenic methyltransferase. Similarly, the As(V) of MMA must be reduced to As(III) before methylation continues, resulting in DMA. Glutathione may be a cofactor in these reactions.

Methylation has been considered a detoxification mechanism since organic arsenic compounds were thought to be less toxic and more easily excreted than inorganic forms. This concept is the subject of considerable debate for at least two reasons. First, the ability to methylate is not

universal among mammals, or even among primates. While humans, mice, rats, and rabbits do methylate inorganic arsenic to MMA and DMA, the guinea pig, marmoset monkey, tamarin monkey, and chimpanzee do not. Second, recent research on the MMA(III) and DMA(III) organic species indicate that these arsenic species are equally or more toxic than the inorganic compounds and are found in human urine. However, the role of individual arsenic species or the variability of human metabolism in the toxicity or carcinogenicity of arsenic is unknown.

Ingestion of organic arsenicals results in little metabolism. Small amounts of MMA may be converted to DMA, but the methylated compounds are not demethylated to inorganic forms in humans or animals. Arsenobetaine, an organic form found in food, is not metabolized.

Excretion

As reviewed by ATSDR (2000), ingested inorganic arsenic is excreted primarily in urine. Very little is eliminated via feces. During lactation, a small portion may be excreted in breast milk. The half-life is approximately 40-60 hours. In humans, arsenic is excreted as 40-60 percent DMA, 20-25 percent inorganic arsenic, and about 15-25 percent MMA. The relative proportions of the inorganic and methylated arsenic species may vary among individuals or populations. The reasons for this variability are not known, but genetic or nutritional differences may influence the metabolism and excretion of arsenic species. The implications of variable arsenic metabolism to susceptibility to arsenic toxicity and carcinogenicity are unknown.

Interactions

As summarized in NRC (1999), arsenic and selenium reduce each other's toxicity in animal models. Although it has been hypothesized that inadequate selenium could increase the toxicity of arsenic in some populations, such as Southwestern Taiwan, there is no evidence of an interaction in humans. Similarly, zinc administered parenterally to experimental animals protected mice from acute arsenic toxicity (Kreppel *et al.*, 1994). Although the nutritional inadequacy with respect to zinc has been suggested as an important consideration for the Taiwanese population, estimated zinc intake in Taiwan was shown to be more than adequate (NRC, 1999).

A few studies have considered the potential interactions between arsenic, copper, and chromium compounds. Mason and Edwards (1989) administered salts of arsenic (As^{+5}), chromium (Cr^{+6}), and copper (Cu^{+2}), separately and in combination, to rats by intraperitoneal injection at two dose levels for each compound. Co-administration of combinations of 10 mg As/kg, 2 mg Cr/kg, and 2 mg Cu/kg resulted in reduced acute toxicity compared to administration of each compound separately. However, co-administration of higher doses of a single compound (36 mg As/kg, 14 mg Cr/kg, or 9 mg Cu/kg) with the lower doses of the other two resulted in increased toxicity relative to toxicity of the compound alone.

Two papers by Gonzalez *et al.* (1995a,b) investigated interactions between arsenate (As^{+5}) and chromium VI (Cr^{+6}) in rats. In general, chromium VI administration increased gastrointestinal absorption of arsenic, enhanced arsenic methylation, and decreased arsenic excretion. The increased arsenic absorption was attributed to corrosive effects of chromium in the gut and chromium-induced alterations in intracellular pH, while the decreased arsenic excretion may have been due to increased reabsorption of arsenic in the renal tubules or to kidney toxicity that resulted in decreased urinary excretion. The authors hypothesized that the effect on arsenic methylation may have been due to the effects of liver damage caused by chromium. This group

also investigated the effects of arsenate (As^{+5}) and chromium III (Cr^{+3}) in feed on plasma glucose and cholesterol levels in rats (Aguilar *et al.*, 1997). While chromium is known to decrease cholesterol levels, arsenic caused a significant increase in plasma cholesterol levels. Co-administration of arsenic and chromium III did not result in significant differences from controls. Plasma glucose levels were not affected by administration of arsenic and chromium, administered separately or together. These three studies involved doses of arsenic and chromium up to about 1 mg/kg body weight.

Mason *et al.* (1989) administered salts of arsenic (As^{+5}), chromium (Cr^{+6}), and copper (Cu^{+2}), separately and in combination, by intraperitoneal injection to pregnant rats on gestation day eight. Separately, 5 mg As/kg, 2 mg Cr/kg, and 2 mg Cu/kg caused no or few maternal or fetal effects. Combinations that included arsenic and chromium caused significant fetal toxicity, although serious maternal toxicity was also noted. In an abstract, Hood *et al.* (1979) reported no significant maternal effects, reproductive, or developmental effects in mice fed CCA treated sawdust in feed during gestation. The dose was given as 10 percent treated sawdust (0.66 lb/ft^3 CCA) in the food, but the corresponding arsenic, chromium, or copper doses were not provided. This abstract also described a study of dermal administration of CCA-treated sawdust in pregnant rabbits. Pregnancy rates were low for both treated and control animals. Other pregnancy outcomes (implantations and live offspring per litter; prenatal mortality; fetal weights) were similar for both groups. In the treatment group, one fetus had a flexed wrist and talipes of the hind limbs, and one fetus had fused ribs. No treatment-related toxicity was observed in the does.

Although humans are commonly exposed to multiple compounds through the environment or diet (both beneficial and potentially toxic), the implication of these results for people exposed to CCA treated wood is unknown. In addition, the experiments described above involved relatively high exposures. Interactions may be less likely at low, environmentally relevant exposures.

Essentiality

Arsenic deprivation has been shown to decrease reproductive success, increase postnatal mortality, and decrease growth in rats, goats, and minipigs (Uthus *et al.*, 1983; and others). No specific biochemical role is known for arsenic, although involvement in arginine or zinc metabolism has been suggested (Nielsen *et al.*, 1980; Uthus *et al.*, 1983). Although arsenic essentiality is suggested in animals, there is no evidence that arsenic is an essential element in humans.

Discussion

Arsenic has a long history as a poison and a medicine. It is ubiquitous in the environment at low levels, although certain natural features and anthropogenic sources can result in increased concentrations in air, soil and dust, water, and food.

Arsenic can exist in a number of compounds. Although inorganic forms are generally more toxic than organic arsenicals, given a sufficiently high dose, most arsenicals will cause adverse effects. Inorganic arsenic species in the As^{+3} and As^{+5} oxidation states are environmentally stable, and most commonly detected in environmental media, such as drinking water. These two forms may interconvert in the environment, and can interconvert in the body, as well. They appear to have similar effects at similar doses, although As^{+3} forms appear to be slightly more toxic than the As^{+5} forms.

In humans, effects of acute exposure include gastrointestinal effects, such as vomiting, diarrhea, abdominal pain, and hemorrhage; and multiple organ effects, especially in the liver and kidney. Neurological effects, including peripheral neuropathy and central nervous system effects, such as seizures and coma, have been seen with high doses (above 2 mg/kg/day). Death has been reported from one-time exposures to 22-121 mg/kg, and from short-term daily exposures as low as about 2 mg/kg/day.

Chronic effects in humans include gastrointestinal, hepatic, hematological, cardiovascular effects, and neurological effects; weight loss; and death. Dermal effects, such as hyperpigmentation and hyperkeratosis, are characteristic of long-term exposures to arsenic. Epidemiological data indicate that arsenic exposure through drinking water may increase the incidence of diabetes and hypertension, and recent *in vitro* work suggests that arsenic interacts with glucocorticoid receptor complexes.

Reproductive and developmental effects, such as spontaneous abortion, stillbirth, preterm birth, and infant mortality, are suggested by epidemiological studies of populations exposed to arsenic in drinking water. Studies in experimental animals show that arsenic compounds cause reduced fetal body weight and fetal death, and may cause malformations after parenteral administration. Very high, maternally toxic doses are required to product these effects by oral administration.

Arsenic-related cancers have been observed from environmental, occupational, and medicinal exposure. In humans, arsenic causes characteristic skin lesions, including skin cancer. Strong evidence exists for other cancers, including lung, bladder, liver, kidney, and prostate. Animal models have historically failed to show similar carcinogenic effects, but recent studies indicate possible proliferative, tumorigenic, and co-carcinogenic effects. In addition, the results of numerous *in vitro* studies indicate multiple effects of arsenic that could be involved in carcinogenicity.

IARC classifies arsenic and arsenic compounds as Group 1, carcinogenic to humans, based on sufficient evidence for lung and skin carcinogenicity in humans (IARC, 1987). The National Toxicology Program Report on Carcinogens (NTP, 2002) classifies arsenic and arsenic compounds as "known to be" human carcinogens. In IRIS, the EPA classified arsenic as group A, a human carcinogen, based on skin, lung and other internal cancers (EPA, 1998).

The Federal Hazardous Substances Act (FHSA) defines a "hazardous substance" as a substance that satisfies both parts of a two-part definition. To meet the statutory definition of a hazardous substance, a product must first present one or more of the hazards enumerated in the statute, that is, it must be toxic, corrosive, flammable, an irritant, or a strong sensitizer, or generate pressure through decomposition, heat, or other means. Second, the product must have the potential to cause substantial personal injury or substantial illness during or as a result of any customary or reasonably foreseeable handling or use, including reasonably foreseeable ingestion by children.

Based on sufficient evidence in humans for multiple acute and chronic effects, the CPSC staff believes that arsenic compounds meet the definition of "toxic" under the FHSA. Based on limited evidence in humans and sufficient evidence in animals, arsenic is a probable developmental toxicant. Based on sufficient evidence in humans, arsenic is a neurotoxicant and a carcinogen. Although the CPSC staff believes that arsenic meets the definition of "toxic" under the FHSA, a quantitative assessment of exposure and risk must be performed on the arsenic-containing household substance to address the second criterion for a "hazardous substance" as defined by the FHSA.

In a study of a region of southwest Taiwan with high average arsenic levels in the drinking water, no effects, including no skin effects, were observed in a population exposed to an estimated 0.0008 mg/kg/day. This level is the no observed adverse effect level (NOAEL). The NOAEL can be used to estimate the acceptable daily intake (ADI) by using an uncertainty factor of ten. This factor of ten is used to account for differences in sensitivity among humans (CPSC, 1992). Thus, the chronic oral ADI for noncancer effects is 0.00008 mg/kg/day (0.08 µg/kg/day). This study was used by EPA to calculate the oral reference dose (RfD) [2] by applying an uncertainty factor of three to get 0.0003 mg/kg/day (0.3 µg/kg/day). The EPA's uncertainty factor was used to account for uncertainty in whether the NOAEL accounts for all sensitive individuals, and to account for lack of data on reproductive toxicity as a critical effect in the studied population. While the CPSC staff uses a default value of ten to account for inter-individual variation, the value of three used by EPA is consistent with their policies. Thus, the factor of three difference between the CPSC's ADI and the EPA's RfD is due to the application of slightly different guidelines, both of which are scientifically valid.

It should be noted that the average intake of inorganic arsenic in the U.S., as estimated by ATSDR (2000), is 0.1-2.6 µg/kg/day. Thus, it is likely that much of the U.S. population is exposed to arsenic at levels that exceed the CPSC staff's estimate of the ADI (0.08 µg/kg/day) and the EPA's RfD (0.3 µg/kg/day).

[2] Both the acceptable daily intake (ADI) and reference dose (RfD) are estimates of the amount of a chemical a person can be exposed to on a daily basis over an extended period of time (up to a lifetime) with a negligible risk of suffering deleterious effects.

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Appendix A

Table I Inorganic Arsenic Compounds				
Compound	CASRN	Oxidation state	Characteristics	Occurrence/Uses
Arsenic	7440-38-2	0	Atomic Weight: 74.92 Appearance: gray solid Solubility: nitric acid; insoluble in water Density: 5.727 g/cm^3 Melting point: 817°C at 28 atm Boiling point: 613°C sublimes	Metal alloy production, such as in lead-acid automobile batteries, bearing type metal, lead ammunition, automotive body solder
Arsenic acid H_3AsO_4	7778-39-4	+5	Molecular Weight: 150.95 Appearance: white solid Solubility: water, alcohol Density: 2.0-2.5 g/cm^3	Herbicide (past use); Decolorizer, fining agent in glass production
Arsenic pentoxide As_2O_5	1303-28-2	+5	Molecular Weight: 229.84 Appearance: white solid Solubility: water, alcohol, acid Density: 4.32 g/cm^3	Chemical reagent; wood treatment formulations
Arsenic trioxide As_2O_5	1327-53-3	+3	Molecular Weight: 197.84 Appearance: white solid Solubility: water, slightly soluble in alcohol, hydrochloric acid Density: 3.738 g/cm^3	Decolorizer, fining agent in glass production; Treatment of acute promyelocytic leukemia
Calcium arsenate $Ca_3(AsO_4)_2$	7778-44-1	+5	Molecular Weight: 398.08 Appearance: colorless solid Solubility: water, dilute acid Density: 3.62 g/cm^3	Agriculture, primarily cotton
Gallium arsenide GaAs	1303-00-0	-3	Molecular Weight: 144.64 Appearance: dark gray solid Solubility: no data Density: 5.31 g/cm^3	Semiconductor production
Arsine	7784-42-1	-3	Molecular Weight: 77.95 Appearance: colorless gas Solubility: water	Semiconductor production
Disodium arsenate Na_2HAsO_4	7778-43-0	+5	Molecular Weight: 185.91 Appearance: solid Solubility: water, glycerol, slightly soluble in alcohol Density: 1.87 g/cm^3	Wood treatment formulations; ant bait; animal dip
Sodium arsenite $NaAsO_2$	7784-46-5	+3	Molecular Weight: 129.91 Appearance: gray-white solid Solubility: water, slightly soluble in alcohol Density: 1.87 g/cm^3	Cattle and sheep dip

Table II Organic Arsenic Compounds				
Compound	CASRN	Oxidation state	Characteristics	Occurrence/Uses
Arsenobetaine $(CH_3)_3As^+CH_2CO_2^-$	64436-13-1	+5	Molecular Weight: 178.06 Appearance: solid Solubility: alcohol	Found in seafood
Arsanilic acid (*p*-aminophenylarsonic acid)	98-50-0	+5	Molecular Weight: 217.04 Appearance: white solid Solubility: water, alcohol, mineral acids	Veterinary medicinal; feed additive for poultry and swine
Roxarsone (4-hydroxy-3-nitrophenylarsonic acid)	121-19-7	+5	Molecular Weight: 263.04 Appearance: pale yellow solid Solubility: soluble in hot water, alcohol, acetic acid, alkalies	Veterinary antibacterial; feed additive
Melarsoprol (2-[4-[(4,6-diamino-1,3,5-triazin-2-yl)amino]phenyl]-1,3,2-dithiarsolane-4-methanol	494-79-1	+3	Molecular Weight: 398.34 Solubility: ethylene glycol	Trypanosomiasis
Dimethylarsinic acid (DMA) $(CH_3)_2As(O)OH$	75-60-5	+5	Molecular Weight: 138.00 Appearance: colorless solid Solubility: water, alcohol, acetic acid	Agriculture, weed control; Mammalian metabolite
Monomethylarsonic acid (MMA) $CH_3H_2AsO_3$	124-58-3	+5	Molecular Weight: 139.97 Appearance: white solid Solubility: water, alcohol	Mammalian metabolite
Disodium methanearsonate (DSMA) $CH_3Na_2AsO_3$	144-21-8	+5	Molecular Weight: 183.9 Appearance: colorless solid Solubility: water, slightly soluble in alcohol	Agriculture, primarily cotton
Sodium methanearsonate (MSMA) $CH_3NaHAsO_3$	2163-80-6	+5	Molecular Weight: 131.96 Appearance: no data Solubility: water	Agriculture, primarily cotton

United States

CONSUMER PRODUCT SAFETY COMMISSION
Washington, D.C. 20207

JAN 22 2003

MEMORANDUM

To: Patricia Bittner, M.S., Project Manager for CCA-Treated Wood in Playground Equipment, Directorate for Health Sciences

Through: Mary Ann Danello, Ph.D., Associate Executive Director, Directorate for Health Sciences
Lori Saltzman, M.S., Division Director, Directorate for Health Sciences

From: Jacqueline Ferrante, Ph.D., Pharmacologist, Directorate for Health Sciences JF

Subject: Toxicity Review of Chromium

Introduction

On May 22, 2001, the Environmental Working Group (EWG) and the Healthy Building Network (HBN) petitioned the U.S. Consumer Product Safety Commission (CPSC) to ban the use of chromated-copper-arsenate (CCA)-treated wood in playground equipment and to initiate a review of its safety for general use (e.g., in decks, picnic tables, and docks). The petitioners argue that "playground equipment and other wood treated with CCA poses imminent and unreasonable health risks to consumers, particularly children."

Wood is treated with CCA, a combination of chromium (as chromium trioxide, $Cr(VI)O_3$), copper (as copper oxide, CuO), and arsenic (as arsenic pentoxide, As_2O_5), to prevent wood deterioration from insects and fungi (AWPA, 2001). Commission staff reviewed the toxicity of the individual constituents of CCA (i.e., chromium, copper, and arsenic). The toxicity of chromium is reviewed in this document.[1]

I. Chemical and Physical Properties

Chromium is an element found in nature with oxidation or valence states ranging from (- II) to (+ VI) (ATSDR, 2000). Elemental chromium [Cr (0)], trivalent chromium [Cr (III)], and hexavalent chromium [Cr (VI)] are the most prevalent valence states (ATSDR, 2000). Depending on the conditions, chromium can change valence state in soil and sediments (Pellerin and Booker, 2000). Chromium compounds have no taste or odor (ATSDR, 2000). Bivalent, trivalent, and hexavalent chromium compounds are basic, amphoteric, and acidic, respectively (Patty's Industrial Hygiene and Toxicology, 1994; Gad, 1989; Katz and Salem, 1993). The air concentration of chromium [Cr (III) and Cr (VI)] is generally low, ranging from 0.01 to 0.03 micrograms (μg) per cubic meter (m^3) (ATSDR, 2000). The concentration of chromium [primarily in the form of Cr (III)] in drinking water is usually less than 2 parts per billion (ppb) or 2 μg/liter (L) (ATSDR, 2000).

Cr (0) is the solid, metal form of chromium that does not occur naturally and is used primarily in alloy (e.g., steel) production (ATSDR, 2000). Cr (III) is an essential human nutrient that exists naturally in numerous fresh vegetables, fruits, meats, and other foods (ATSDR, 2000; Barceloux, 1999). In combination with niacin and three amino acids it forms glucose tolerance factor (GTF) which potentiates insulin action (Katz, 1991). Although data are inadequate for determining a recommended daily allowance for chromium, the estimated safe and adequate daily dietary intake for adults ranges from 50 to 200 μg (RDA, 1989; ATSDR, 2000). Adults in the U.S. consume an average estimated 60 μg

[1] Much of the information in this document is derived from a recent (September 2000) toxicological profile of chromium published by the Agency for Toxic Substances and Disease Registry (ATSDR).

of chromium per day (ATSDR, 2000). Cr (III) compounds are generally insoluble in water (except the acetate, hexahydrate of chloride, and nitrate salts) (ATSDR, 2000).

Cr (VI) rarely exists naturally, but various industries emit Cr (VI) compounds into the air, water, and soil (Pellerin and Booker, 2000). Cr (VI) compounds have a number of industrial applications including chrome plating, leather tanning, stainless steel welding, and dye and pigment production (ATSDR, 2000). In soil, Cr (VI) compounds are reduced to the trivalent form by oxidizable organic matter. Some Cr (VI) compounds (e.g., Cr (VI) oxide, ammonium and alkali metal salts of chromic acid) are readily water soluble (ATSDR, 2000). Table 1 summarizes the chemical and physical properties of chromium and some chromium compounds.

Table 1. Physical and Chemical Properties of Chromium

Form	Molecular Weight	Density (g/cm^3)	Melting (°C)	Water Solubility
Chromium, Cr	51.99	7.2 (28 °C)	1,857	Insoluble
Chromium (III) Chloride:$CrCl_3$	158.36	2.76 (15 °C)	1,150	Slightly soluble in hot water.
Chromium (III) Sulfate: $Cr_2(SO_4)_3$	392.16	3.01*	No data	Insoluble
Potassium Dichromate (Chromium (VI)) $K_2Cr_2O_7$	294.18	2.68 (25 °C)	398	4.9 g/100 ml at 0 °C
Chromium (VI) Trioxide:CrO_3	99.99	2.70 (25 °C)	196	61.7 g/100 ml at 0 °C
Calcium chromate (Chromium (VI)) $CaCrO_4$	156.01	2.89*	No data	2.23 g/100ml*

*Temperature not specified
References: Patty's Industrial Hygiene and Toxicology, 1994 and ATSDR, 2000.

II. Toxicity

Acute Toxicity

Generally, Cr (III) is less toxic than Cr (VI) because it is less readily absorbed across cell membranes (Patty's Industrial Hyg. and Tox., 1994; ATSDR, 2000). Acute oral LD_{50} values in rodents vary depending on the

particular chromium compound, with those measured for Cr (III) and Cr (VI) ranging from 183 to 2365 milligrams (mg)/kilogram (kg) and 13 to 811 mg/kg, respectively (ATSDR, 2000). In one study, single-dose dermal LD_{50} values in rabbits exposed to various Cr (VI) compounds ranged from 336 to 763 mg/kg in both sexes (Gad et al., 1986; ATSDR, 2000). Observed effects included dermal corrosion and necrosis, diarrhea, hypoactivity, and scab formation (Gad, 1989). The skin damage may have increased the absorption of these compounds explaining the low dermal LD_{50} values. In another report, the dermal LD_{50} for chromium trioxide was 30 mg Cr (VI)/kg (ATSDR, 2000; American Chrome and Chemical, 1989). Acute inhalation LC_{50} values in rats for several Cr (VI) compounds ranged from 29 to 137 mg Cr (VI)/m^3 for both males and females following a four hour exposure (Gad et al., 1986; ATSDR, 2000; American Chrome and Chemical, 1989).

There are limited poisoning data available for Cr (III) compounds due to their low acute toxicity. Cr (III) is available as a dietary supplement in the form of chromium picolinate ($C_{18}H_{12}CrN_3O_6$), a complex of one molecule of Cr (III) and three molecules of picolinic acid (Poisindex, 2001). Chromium picolinate supplements may contain other ingredients such as niacin and pyridoxine. A human toxic dose for chromium picolinate has not been established and toxicity appears unlikely after a single acute overdose (Poisindex, 2001; Ellenhorn, 1997).

Symptoms observed in nine cases of adult ingestion exposures (acute and chronic) to chromium picolinate included dizziness (one report), headache (two), and agitation (one) (Gorman and Herrington, 1997). Five of 16 children exposed to 100 to 6000 μg of chromium picolinate were asymptomatic, nine had minimal symptoms, and two experienced drowsiness that was considered unrelated (Poisindex, 2001; Gorman and Herrington, 1997).

The acute toxicity profile for hexavalent chromium salts is well defined in humans. According to the Poisindex, "acute poisoning is likely to occur through the oral route, whereas chronic poisoning is mainly from inhalation or skin contact." Effects observed after oral exposures to hexavalent chromium include oral burns, gastrointestinal (GI) irritation/ulceration/corrosion, vomiting, diarrhea, vertigo, fever, toxic nephritis, renal failure, circulatory collapse, liver damage, acute multi-system shock, coma, and death (Poisindex, 2001). Ingestion of 0.5 grams (g) of hexavalent chromium produced serious toxicity and dermal exposure involving 10% of the body surface has been fatal. The estimated lethal oral dose of hexavalent chromium is 1 to 3 g (about 14 to 43 mg/kg based on a weight of 70 kg) in adults and 10 mg/kg in children (Poisindex, 2001).

Table 2 summarizes a sample of acute exposures in humans to hexavalent chromium compounds.

Table 2. Effects of Acute Oral Exposure to Cr (VI) Compounds in Humans.

Compound/ Dose	Age	Symptoms/Outcome	Reference
Ammonium Dichromate (1 g)	22 mos	Hypotension, GI ulceration, pulmonary & cerebral edema/Death	Meert et al., 1994
Sodium Dichromate	22 mos	Pulmonary edema, bronchopneumonia, & cardiac/liver/GI/ renal effects/Death	Ellis et al., 1982
Potassium Dichromate	16 yrs	Abdominal pain, vomiting, bleeding GI lesions, liver failure, coma/Recovered after liver transplant	Stift et al., 1998.
Unidentified Cr (VI) compound	11 yrs	Circulatory insufficiency, coma, diarrhea, acute liver failure/Recovered	Ulmeanu et al., 1997
Potassium Dichromate [29 mg Cr (VI)]	17 yrs	Caustic GI burns & hemorrhaging/Death	Clochesy, 1984; Iserson et al., 1983
Potassium Dichromate [7.5 mg Cr (VI)]	14 yrs	GI ulceration, severe liver & kidney damage/Death	Kaufman et al., 1970
Chromic acid 50 ml [25 g Cr (VI)]	35 yrs	GI hemorrhage, vomiting encephalopathy, hypotension, acute renal failure, coma/Death	Loubieres et al., 1999.

Subchronic and Chronic Toxicity

There are a few reports showing toxic effects after chronic ingestion of chromium picolinate (Poisindex, 2001). Toxicity was documented following ingestion of 1200 to 2400 μg chromium (III) picolinate/day for 4 to 5 months by an adult female (Cerulli et al., 1998). Her plasma chromium measured two to three times the normal concentration. She developed thrombocytopenia, hemolysis, hepatic dysfunction, and renal failure. Following treatment, the patient recovered with normal liver and renal function.

Given its widespread industrial use, there are many epidemiologic studies and case reports describing the health effects of Cr (VI) compounds in humans

(Baruthio, 1992; ATSDR, 2000). Inhalation of aerosols or dusts and direct skin contact are the primary routes of exposure in occupational settings (Baruthio, 1992). As a result, reported effects include contact dermatitis, irritation or ulceration of the nasal mucosa, respiratory complications (e.g., chronic bronchitis, pulmonary fibrosis, emphysema, and pulmonary sensitization), dizziness, and headaches (Poisindex, 2001; ATSDR, 2000).

Systemic effects on the liver, kidneys, and blood have been documented after chronic chromium exposure, but are rare and some results are equivocal (Poisindex, 2002; ATSDR, 2000). Generally, chronic exposure to chromium may produce mild to moderate liver abnormalities and transient renal effects (low doses) (ATSDR, 2000). Other effects from chronic exposure to Cr (VI) are discussed in detail below.

Reproductive/Developmental Effects

While reproductive and developmental data are limited in humans, studies in animals suggest that chromium (primarily Cr (VI)) is teratogenic and causes reproductive effects (ATSDR, 2000; Barceloux, 1999). Generally, following oral exposure to chromium, females had fewer offspring (some with birth defects) and males had decreased sperm counts (ATSDR, 2000). These effects were observed "at levels about several thousand times higher than the normal daily intake by humans" (ATSDR, 2000).

In the only three-generation inhalation rat study available, no developmental effects were observed after maternal exposure to 0.2 mg Cr (VI)/m^3 in the form of sodium dichromate (ATSDR, 2000; Glaser et al., 1984).

A recent human study examined the reproductive effects (sperm quality and hormone levels) of occupational exposure (presumably via inhalation) to Cr (VI) in 21 workers in an electroplating factory (Li et al., 2001). The precise Cr (VI) compound (probably chromium trioxide (CrO_3) since this compound is used for electroplating and the authors used it for their animal study, see below) and the exposure concentration were not reported, but the exposure duration ranged from 1 to 15 years. Workers in the same factory who "were not exposed to any harmful chemicals" served as the control group. While there were no significant differences in serum and seminal fluid chromium concentrations between the exposed and control workers, the seminal fluid of exposed workers had significantly reduced 1) sperm counts and motility; 2) zinc levels; and 3) lactate dehydrogenase and lactate dehydrogenase C4 isoenzyme levels. Additionally, the serum of exposed workers had significantly higher levels of follicle stimulating hormone than the control group.

This study also examined the effects of Cr (VI) in rats, but only two concentrations were tested (Li et al., 2001). Rats orally exposed to 10 or

20 mg/kg CrO_3 (~ 5.2 to 10.4 mg Cr/kg) daily for six days had significantly reduced sperm counts and morphologically abnormal sperm compared to controls. The results of other rodent studies involving oral exposure to chromium are summarized in Table 3 (ATSDR, 2000).

Table 3. Selected Rodent Studies Showing Reproductive and Developmental Effects of Oral Exposure to Chromium (ATSDR, 2000).

Chromium form/ Species/ Exposure duration	Effects at LOAEL	NOAEL or LOAEL (mg Cr/kg/day)	Reference
Trivalent chromium			
Cr_2O_3 (III)/Rat 90 days/5 days/wk	None	NOAEL = 1806	Ivankovic & Preussman, 1975
$CrCl_3$ (III)/Mouse 12 wks	Increased testes & reduced preputial gland weights:	LOAEL = 5 (males)	Elbetieha & Al-Hamood, 1997
	Decreased # pregnant females	LOAEL = 13 (males)	same as above
	Decreased # of implantations & viable fetuses; increased ovarian & decreased uterine weights.	LOAEL = 5 (females)	same as above
$Cr_2(SO_4)_3$ Mouse/7 wks	Decreased spermatogenesis	LOAEL = 9.1 (males)	Zahid et al., 1990
$CrCl_3$ (III)/Mouse/ gestational day 12 lactational day 20	Reduced ovary & testis weights in offspring & impaired fertility in female offspring.	LOAEL = 74	Al-Hamood et al., 1998.
$CrCl_3$ (III)/Rat 12 weeks	Altered sexual behavior decreased absolute testes, seminal vesicles, & preputial gland weights	LOAEL = 40	Bataineh et al.,1997
Hexavalent chromium			
$K_2Cr_2O_7$ (VI)/Rat/12 wks	Same as above	LOAEL = 42	Bataineh et al.,1997
$Na_2Cr_2O_7$ (VI)/Rat 90 days, 1x/day	Decreased testicular protein serum testosterone, & 3 B-hydroxy steroid dehydrogenase	LOAEL = 20	Chowdury & Mitra, 1995
$Na_2Cr_2O_7$ (VI)/Rat 90 days, 1x/day	Decrease in testicular weight (28%) & testosterone levels, spermatids spermatocytes, Leydig cells, pachytene cells, testicular protein, DNA, RNA, & seminiferous tubular diameter	LOAEL = 40	Chowdury & Mitra, 1995
$K_2Cr_2O_7$ (VI)/Rat/20 days	Increased resorptions	LOAEL = 37	Kanojia et al.,1996
$K_2Cr_2O_7$ (VI)/Rat 3 months	Decreased fertility, increased pre- & post-implantation loss, reduced fetal weight, reduced fetal caudal ossification	LOAEL = 45	Kanojia et al.,1998
$K_2Cr_2O_7$ (VI)/Rat/9week		NOAEL = 8.4 in males 9.8 in females	NTP, 1996
$K_2Cr_2O_7$ (VI)/Mouse/9week		NOAEL = 32.2 in males 48 in females	NTP, 1996
$K_2Cr_2O_7$ (VI)/Mouse 85 days + postnatal day 1-74 (F1) + postnatal day 1-21 (F2)		NOAEL = 36.7 in females	NTP, 1997

Carcinogenicity/Mutagenicity

The carcinogenicity of Cr (VI) in humans and animals via inhalation is well established (ATSDR, 2000; DeFlora, 2000; Katz, 1993). A number of Cr (VI) compounds (calcium chromate, chromium trioxide, lead chromate, strontium chromate, and zinc chromate) are linked to respiratory system cancers (bronchogenic and nasal) in workers following inhalation exposure (ATSDR, 2000). Cr (VI) also causes genetic effects *in vitro* (De Flora, 2000). In a recent review article on chromium carcinogenesis, De Flora concluded that most *in vitro* mutagenicity studies with Cr (VI) compounds were positive while studies with Cr (III) compounds were predominantly negative (De Flora, 2000). Generally, Cr (VI) compounds with low solubility had less mutagenic activity and Cr (III) compounds only tested positive at doses two or three orders of magnitude higher than that required to achieve similar results with Cr (VI) compounds (De Flora, 2000).

In vivo genotoxicity studies involving workers exposed to Cr (VI) in the stainless steel and electroplating industries showed contradictory results (ATSDR, 2000; De Flora, 2000). Some studies reported either no changes or higher levels of chromosomal aberrations or sister chromatid exchanges in the peripheral lymphocytes of welders or electroplaters compared to controls (ATSDR, 2000; Nagaya, 1991; Werfel et al., 1998). The ATSDR cited several reasons for these results including unknown exposure levels, co-exposure to other potentially genotoxic metals (e.g., nickel), and small sample sizes in some of the studies.

Animals exposed by inhalation to aerosols of Cr (VI) compounds (calcium chromate and sodium dichromate) showed a small increase in lung tumor incidence (ATSDR, 2000; Glaser et al., 1986). In other animal studies, carcinomas or sarcomas developed at the site of implantation or injection of a number of Cr (VI) compounds (e.g., calcium chromate, chromium trioxide, lead chromate, and zinc chromate), but none of these administration routes (intrapleural, intramuscular, subcutaneous, intravenous, intrabronchial) reflect actual human exposure scenarios (ATSDR, 2000; DeFlora, 2000).

Epidemiological studies spanning over 100 years have demonstrated a link between occupational exposure (e.g., chromate production and chromate pigment industries) to Cr (VI) compounds and respiratory cancers (ATSDR, 2000; De Flora, 2000). Non-cancerous respiratory effects have also been observed. Occupational exposure to chromium may be two orders of magnitude greater than that to the general population (NTP, 9th Report on Carcinogens, 2000). Table 4 summarizes some studies showing the respiratory effects of occupational inhalation of chromium.

Table 4. Occupational Exposure to Chromium via Inhalation (ATSDR, 2000)

Chromium Form/ Exposure duration	Effect	LOAEL (mg Cr/m^3)	Reference
Cr (III), (VI), chromite dust/ > 8 yr	none	NOAEL = 0.022	Huvinen et al., 1996.
CrO_3 (VI)/3 - 6 yr Avg = 7.5 yr	epistaxis rhinorrhea, nasal septum ulceration & perforation	0.004	Lucas and Kramkowski, 1975.
CrO_3 (VI)/0.2 - 23.6 yr Avg = 2.5 yr	nasal mucosa atrophy, mild decreased lung function	0.002	Lindberg & Hedenstierna, 1983.
Mixed Cr (III) & (VI)/ 90 days to 5 years	lung cancer	0.413	Hayes et al., 1979 Braver et al., 1985
$PbCrO_4$ & $ZnCrO_4$ (VI)/ 1 month to 29 years	lung cancer	0.5 males	Hayes et al., 1989.
$PbCrO_4$ & $ZnCrO_4$ (VI)/ 4 to 19 years	lung cancer	0.5	Langard & Norseth, 1975.
Mix of Cr (VI) & Cr (III)/ 1 to 49 years	lung cancer	0.04 males	Langard et al., 1980.
Insoluble Cr (III)/ 1 to 7 years	lung cancer	0.25	Mancuso, 1975.
Mix of Cr (VI) & Cr (III)/ 1 to 7 years	lung cancer	0.5	Mancuso, 1975.
Soluble Cr (VI)/ 1 to 7 years	lung cancer	0.25	Mancuso, 1975.
Mix of soluble Cr (VI) & Insoluble Cr (III)/1 to 7 years	lung cancer	0.25	Mancuso, 1997.
$PbCrO_4$ & $ZnCrO_4$ (VI)/ 1 month to 29 years	lung cancer	0.1 males	Sheffet et al., 1982.

Occupational exposure = 5 days/wk, 8 hours/day

The mechanism for the carcinogenicity of Cr (VI) may involve its intracellular reduction to Cr (V), Cr (IV), Cr (III), and hydroxyl free radicals (ATSDR, 2000). These reduction products can interact and damage DNA

causing single-strand breaks, DNA-protein crosslinks, DNA-DNA interstrand crosslinks, chromium-DNA adducts, and chromosomal aberrations (ATSDR, 2000; De Flora, 2000).

The International Agency for Research on Cancer (IARC) concluded that Cr (VI) is a Group 1 carcinogen (i.e., known human carcinogen) in humans whereas Cr (0) and Cr (III) are not classifiable as human carcinogens (Group 3) (DeFlora, 2000). Moreover, the U.S. Environmental Protection Agency's (EPA) Integrated Risk Information System (IRIS) designated Cr (VI) as a Group A human carcinogen by inhalation and Cr (III) as Group D (not classified as to its human carcinogenicity) (HSDB, 2002). Table 5 summarizes some of the regulations and guidelines established for chromium by various agencies (ATSDR, 2000).

Table 5. Classification and Health Standards for Chromium (ATSDR, 2000)

Agency	Substance	Air Standard (mg/m^3)	Cancer Classification
IARC	Cr (0)		Group 3 (Not classifiable as to carcinogenic potential)
	Cr (III)		Group 3
	Cr (VI)		Group 1 (carcinogenic in humans)
EPA	Cr (III)	RfC – not available	Group D (not carcinogenic
EPA	Cr (VI)	RfC = 1.2×10^{-2}	Group A (human carcinogen)
	Chromic acid mists & dissolved Cr (VI) aerosols	RfC = 8.0×10^{-6}	
	Cr (VI) particulates	RfC = 1.0×10^{-4}	
NIOSH		REL 8-hour TWA	
	Chromium metal	0.5	
	Cr (II)	0.5	
	Cr (III)	0.5	
	Cr (VI)	0.001	
	Chromyl chloride	0.001 mg (Cr VI)/m^3	Carcinogenic
ACGIH		TLV-TWA	
	Chromium, metal & Inorganic compounds as chromium	0.5	
	Metal & Cr (III)	0.05	
	Water soluble Cr (VI)	0.01	
OSHA		8-Hour TWA	
	Cr (II)	0.5	
	Cr (III)	0.5	
	Cr metal & insoluble Salts	1.0	
	Chromic acid & chromates	0.1 mg CrO_3/m^3	

RfC - inhalation reference concentration
REL - recommended exposure limit
TWA - time weighted average
TLV - threshold limit value

IARC - International Agency for Research on Cancer
EPA - Environmental Protection Agency
NIOSH - National Institute for Occupational Safety & Health
ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety & Health Administration

Carcinogenicity (continued)

While Cr (VI) is considered a human carcinogen by inhalation, the carcinogenic potential of chromium by ingestion is unclear, in part, due to the lack of data. Mice given 9 mg/kg/day Cr (VI) as potassium chromate in drinking water for three generations (880 days) showed a small increase in primarily benign forestomach papillomas (Borneff et al.,1968 as cited in the ATSDR, 2000; 67 FR 36620). In another rodent study, there was no evidence of carcinogenicity in rats fed 1%, 2%, and 5% chromium (III) oxide (Cr_2O_3) for two years (total consumption was between 360 and 1800 g Cr_2O_3/kg) (Ivankovic and Preussman, 1975).

Recently, the California Environmental Protection Agency, the California Health and Human Services Agency, and some California legislators nominated a study of the carcinogenic potential of Cr (VI) in drinking water to the National Toxicology Program (NTP) (NTP Factsheet, July 2002). The NTP study plan for Cr (VI) includes a toxicokinetic component, 90-day oral toxicity studies in rodents, and 2-year rodent cancer studies in drinking water. These data will be useful in determining whether Cr (VI) poses a hazard following long-term oral exposure.

Dermal/Ocular Effects

Effects from dermal and ocular exposure to chromium are primarily due to the acidity and oxidizing potency of the particular compound (Gad, 1989). While Cr (III) compounds are unlikely to cause serious dermal effects, Cr (VI) compounds (e.g., potassium dichromate and sodium chromate) can be corrosive causing skin burns, blisters, corneal edema, and deep perforating ulcers or "chrome holes" (Poisindex, 2001; ATSDR, 2000; Paustenbach et al., 1992; Gad, 1989; Baruthio, 1992). Moreover, systemic toxicity may develop because skin damage from the burns promotes absorption of the chromium compound (Poisindex, 2001). Dermal exposure to Cr (VI) may be fatal. A 49-year-old male died after a spray of hot chromic acid caused burns covering 40% of his body surface (Wang et al., 1985).

Inhalation exposure can also produce caustic effects. Chromate workers exposed to airborne chromium compounds (e.g., potassium dichromate) had inflamed mucous membranes, keratosis of the lips, gingivitis, and ulceration or perforation of the nasal septum (ATSDR, 2000; Gibb et al., 2000).

Chromium is a well known contact allergen that produces Type IV or delayed hypersensitivity reactions (Casarett & Doull's, 1996; Paustenbach et al., 1992). Most cases of allergic contact dermatitis occur following occupational exposure (e.g., chrome-plating, leather tanning, wet cement workers) to Cr (VI) compounds (Baruthio, 1992; Paustenbach et al., 1992). Animal studies corroborate the human findings (ATSDR, 2000). The mechanism for chromium sensitization may involve the formation of allergenic Cr (III)-protein complexes (Baruthio, 1992; ATSDR, 2000). Trivalent chromium can also be allergenic at

high concentrations (Estlander et al., 2000), but the hexavalent form elicits sensitization reactions more frequently and of a greater magnitude (Paustenbach et al., 1992).

Neurologic Effects

There are limited data related to neurologic effects from exposure to chromium (ATSDR, 2000). Encephalopathy, cerebral edema, and coma (Table 2) have been observed following acute exposure to Cr (VI) compounds, but these effects may have occurred secondary to hepatic and renal failure (ATSDR, 2000; Poisindex, 2001). More studies are needed to delineate the neurotoxic potential of chromium. Given the available data, the nervous system does not appear to be a primary target of chromium toxicity.

III. Absorption, Distribution, Metabolism, & Elimination (ATSDR, 2000)

Absorption

Chromium is absorbed from the GI tract and the lungs. Generally, Cr (VI) compounds are absorbed better than Cr (III) compounds because chromate ions (CrO_4^{-2}) enter cells by facilitated diffusion through non-specific anion channels, whereas Cr (III) compounds are absorbed by passive diffusion and phagocytosis (ATSDR, 2000).

Absorption of inhaled chromium compounds depends on various factors, including oxidation state, particle size, solubility, and alveolar macrophage activity (Barceloux, 1999). Chromium has been detected in the urine, serum, and other tissues of workers exposed to soluble Cr (III) and Cr (VI) in air (Mancuso, 1997). One study showed that six chromate workers exposed to chromium for over 10 years had a higher tissue content of chromium than non-exposed controls (Kishi et al., 1987). Animal studies show that the lungs absorb 53 to 85% of Cr (VI) compounds (particle size < 5 um) and 5 - 30% of Cr (III) compounds (ATSDR, 2000).

The oral bioavailability of chromium depends primarily on solubility and valence state (Paustenbach et al., 1997). Oral absorption of dietary Cr (III) in humans is low and absorption efficiency is generally greater at low levels of dietary intake (ATSDR, 2000). Studies in animals and humans show that the GI tract reduces Cr (VI) to Cr (III) which explains the poor oral absorption of Cr (VI) (De Flora, 2000; ATSDR, 2000). The oral absorption of freely soluble Cr (VI) and Cr (III) is usually less than 8% and 1%, respectively (Paustenbach et al., 1997). To reach potentially toxic amounts of Cr (VI) via the oral route, large doses of Cr (VI) are needed to avoid reduction to Cr (III) in the stomach (Barceloux, 1999).

Dermal absorption is dependent on the particular chromium compound, the vehicle, and skin integrity (ATSDR, 2000). Skin penetration is limited for both

Cr (III) and Cr (VI) compounds except after exposures that cause chemical burns (e.g., concentrated solutions of Cr (VI) compounds) (Barceloux, 1999).

Distribution

Following absorption in the blood, chromium compounds are distributed to all body organs (ATSDR, 2000). Cr (III) binds primarily to serum transferrin while Cr (VI) penetrates erythrocytes (red cells) and binds to hemoglobin (Barceloux, 1999). Cr (VI) has a short intracellular half-life since it is readily reduced to Cr (III) (Poisindex, 2001; Barceloux, 1999). Chromium may also be transferred to fetuses and infants via the placenta and breast milk, respectively (ATSDR, 2000).

An autopsy study showed that subjects from a region in Germany, where chromium emissions are high, had lung concentrations of chromium that were five times higher than subjects from another non-polluted region (Kollmeier et al., 1990). Moreover, the concentration of chromium in the lungs increased with age (Poisindex, 2001; Kollmeier et al., 1990).

Chromium particles can be retained in the lungs for years after occupational exposure (Kishi et al., 1987; Mancuso, 1997; ATSDR, 2000). Tissues examined 3.5, 18, and 0.6 years after three workers with lung cancer were exposed to chromium for 15, 10.2, and 31.8 years, respectively, showed elevations of chromium in all tissues except neural tissue (Mancuso, 1997). The level of chromium in the lungs was orders of magnitude higher than in other tissues.

Metabolism

Cr (VI) is unstable in the body and is reduced to Cr (III) by a number of reducing substances including microsomal electron transport systems involving nicotinamide adenine dinucleotide phosphate ($NADP^+$/NADPH), heme proteins, flavoproteins, ascorbic acid, and glutathione (Gruber and Jennette, 1978; Petrilli et al., 1986; Suzuki and Fukuda, 1990). Cr (VI) is reduced in human plasma, erythrocytes, saliva, and gastric juice (Petrilli et al., 1986; Finley et al., 1997). Cr (V) and Cr (IV) are transient intermediates in the reduction process (ATSDR, 2000). Cr (III) may also form complexes with proteins and nucleic acids (ATSDR, 2000).

Studies in rodents show that Cr (VI) can be reduced to Cr (III) in the lungs by ascorbate and glutathione (Suzuki and Fukuda, 1990). Additionally, *in vitro* studies have shown that rat hepatic microsomal enzymes can also reduce Cr (VI) to Cr (III) (Gruber and Jennette, 1978). However, the reduction of Cr (VI) in rat hepatic microsomes is dependent on NADPH and other factors (e.g., cytochrome P450).

Human studies have shown that epithelial lining fluid (ELF) extracted from 15 subjects by bronchial lavage and cell extracts from pulmonary alveolar macrophages from 5 healthy males reduced Cr (VI) to Cr (III) (Petrilli et al., 1986). The average reduction was 0.6 ug Cr (VI)/mg of ELF protein and 4.8 ug Cr (VI)/10^6 cells.

Elimination

Absorbed chromium is excreted primarily in the urine (~ 80%) with the remainder excreted through the bile (~ 10%), feces, sweat, hair, nails, and milk (Barceloux, 1999; HSDB, 2001; Finley et al., 1997). The half-life for urinary excretion in humans has been determined following inhalation and ingestion exposures (Kiilunen et al., 1983; Kerger et al., 1996; Tossavainen et al., 1980). An inhalation study showed that the urinary half-life of chromium in five workers exposed to chromium (III) lignosulfonate dust ranged from 4 to 10 hours (Kiilunen et al., 1983). In another study, the half-life of Cr (VI) in workers exposed to welding fumes ranged from 15 to 41 hours (Tossavainen et al., 1980).

Chromium excretion was also examined in humans following ingestion in drinking water (Kerger et al., 1996; Kerger et al., 1997; Finley et al., 1997). Urinary excretion half-lives were determined in four adult male volunteers who ingested a single dose of chromium (5 mg) in 0.5 liters of water (Kerger et al., 1996). Three different chromium mixtures were used: 1) Cr (III) chloride; 2) potassium dichromate [Cr (VI)]; and 3) potassium dichromate reduced to Cr (III) with orange juice. The half-life values for the three mixtures were approximately 10, 17, and 39 hours, respectively.

IV. Discussion and Conclusion

Chromium is a naturally occurring metallic element that may be toxic depending upon its valence state and the route of exposure. Most evidence shows that Cr (VI) is more toxic than Cr (III). Cr (III) is an essential human nutrient with low acute toxicity. The estimated safe and adequate daily dietary intake for Cr (III) is 50 to 200 ug for adults. Some Cr (VI) compounds are corrosive with acute oral and dermal exposures resulting in lethality. Ingestion of 0.5 g of Cr (VI) produced serious toxicity in humans and the estimated lethal oral dose in adults is 14 to 43 mg/kg and that in children is 10 mg/kg.

Apart from its irritant and corrosive properties, Cr (VI) is a strong skin sensitizer with most cases of contact dermatitis reported after occupational exposure. Cr (III) is also allergenic, but higher concentrations are needed to induce a response.

There is sufficient evidence of carcinogenicity in humans from inhalation of high levels of Cr (VI) during occupational exposure. Respiratory cancer has been observed for decades in workers exposed to various Cr (VI) compounds in

the chromate production, chrome pigment, and chrome plating industries. As a result, the federal government established standards to protect workers from harmful exposures (Table 5). Therefore, it may be concluded that Cr (VI) is a known human carcinogen based on sufficient evidence from epidemiological studies. This conclusion is further supported by carcinogenicity studies in animals and *in vitro* mutagenicity studies.

While human data related to reproductive and developmental effects are inadequate, there is sufficient evidence of reproductive and developmental toxicity from animal studies involving oral exposure to chromium (primarily hexavalent chromium). Therefore, chromium is a probable reproductive and developmental toxicant in humans. There is insufficient information on dose-response relationships to derive an acceptable daily intake from the animal studies.

The FHSA defines a "hazardous substance" as a substance that satisfies both parts of a two-part test. To be a hazardous substance, a product must first present one or more of the hazards enumerated in the statute, that is, it must be toxic, corrosive, flammable, an irritant, or a strong sensitizer, or generate pressure through decomposition, heat, or other means. Second, the product must have the potential to cause substantial personal injury or substantial illness during or as a result of any customary or reasonably foreseeable handling or use, including reasonably foreseeable ingestion by children. Exposures to chromium from playgrounds are most likely to occur through the oral and dermal routes.

In evaluating the potential hazards presented by chromium compounds, the Commission staff has followed the definitions for toxicity (both acute and chronic), irritance, and sensitization in the FHSA and its implementing regulations, 16 CFR part 1500. It is the opinion of CPSC staff that chromium (particularly Cr VI) meets the definition of toxic under the FHSA, but a quantitative assessment of exposure and risk is required to determine whether it would appear to satisfy the second element of the statutory definition when present in playground equipment as a result of the use of wood treated with CCA in its construction. Currently, there is insufficient information for the staff to conduct the second part of the analysis to determine what, if any, hazards chromium presents as a component of the wood used in playgrounds. Such an analysis would include an assessment of oral and dermal exposure, as well as additional data on the chronic health effects from oral exposure.

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