University of Wollongong

Science Technology and Society

University of Wollongong
NSW 2522 Australia

Tele: 0242 214603
Fax 0242 213452
International +61 242
Email: sbeder@bigpond.net.au
http://homepage.mac.com/herinst/
sbeder/home.html

February 9, 2006

Productivity Commission
LB2 Collins Street East
Melbourne
VIC 8003.

Dear Sir/Madam

Re: Waste Generation & Resource Efficiency Inquiry

I would like to bring to your attention, the problems associated with the disposal of CCA-treated timber. The disposal of CCA-treated timber is of great concern because of the large volume of anticipated waste and the lack of safe disposal options, given the toxicity of the treated timber. If CCA-treated timber is incinerated the smoke and the ash can be toxic, so it is usually disposed of in municipal landfills in Australia, where it continues to leach arsenic. In Europe it is categorised as a hazardous waste for these reasons.

Reuse options are limited because of the risks associated with them but they are being developed to minimize this risk. In particular, CCA-treated timber should not be reused for garden mulch or animal bedding or for any use where humans and animals can have close contact with it. Methods to remove the toxic components from the treated wood are still in their infancy and have cost or environmental problems associated with them.

I have attached the relevant chapter from a report that Nina Lansbury and I have prepared on CCA-treated timber which outlines the problems associated with CCA-timber as a waste product. In it we concluded that it was necessary to:

classify CCA-treated timber waste as hazardous waste and ensure its safe disposal

The full report is available for download at:
http://homepage.mac.com/herinst/CCAtimber/home.html

Yours sincerely,

Professor Sharon Beder.

excerpt from:

Treated Timber, Ticking Time-bomb

The Need for a Precautionary Approach to the Use of Copper Chrome Arsenate (CCA) as a Timber Preservative

February 2005

Authors:

Nina Lansbury Hall and Sharon Beder
ninalansbury@hotmail.com sharonb@uow.edu.au

University of Wollongong, NSW, Australia

Full report at: http://homepage.mac.com/herinst/CCAtimber/home.html

TABLE OF CONTENTS

ACKNOWLEDGEMENTS ..... ERROR! BOOKMARK NOT DEFINED.

ABBREVIATIONS **4**

EXECUTIVE SUMMARY ..... ERROR! BOOKMARK NOT DEFINED.

1 INTRODUCTION ..... ERROR! BOOKMARK NOT DEFINED.

1.1 RESEARCH AIMS ..... **ERROR! BOOKMARK NOT DEFINED.**
1.2 CCA-TREATED TIMBER 8

2 HEALTH IMPACTS ..... ERROR! BOOKMARK NOT DEFINED.

2.1 CHILDRENS' HEALTH ..... **ERROR! BOOKMARK NOT DEFINED.**
2.2 PRECAUTIONARY PRINCIPLE ..... **ERROR! BOOKMARK NOT DEFINED.**
2.3 WORKING WITH TREATED TIMBER ..... **ERROR! BOOKMARK NOT DEFINED.**
2.4 HEALTH-RELATED LITIGATION ..... **ERROR! BOOKMARK NOT DEFINED.**
2.5 INDUSTRY RESPONSES ..... **ERROR! BOOKMARK NOT DEFINED.**

3 ENVIRONMENTAL IMPACTS ..... ERROR! BOOKMARK NOT DEFINED.

3.1 LEACHING INTO SOIL AND GROUNDWATER ..... **ERROR! BOOKMARK NOT DEFINED.**
3.2 IMPACTS ON MARINE WATER ..... **ERROR! BOOKMARK NOT DEFINED.**

4 WASTE OPTIONS **21**

4.1 VOLUMES 22
4.2 INCINERATION 22
4.3 REUSE 24

5 WHAT ARE CCA CONSUMERS BEING TOLD? ..... ERROR! BOOKMARK NOT DEFINED.

6 REGULATORY CONTEXT **30**

6.1 EUROPEAN UNION ..... **ERROR! BOOKMARK NOT DEFINED.**
6.2 NORTH AMERICA ..... **ERROR! BOOKMARK NOT DEFINED.**
6.3 AUSTRALIA ..... **ERROR! BOOKMARK NOT DEFINED.**
6.4 STANDARDS AUSTRALIA ..... **ERROR! BOOKMARK NOT DEFINED.**
6.5 APVMA REVIEW ..... **ERROR! BOOKMARK NOT DEFINED.**
6.5 RESPONSES TO APVMA REVIEW ..... **ERROR! BOOKMARK NOT DEFINED.**

7 ALTERNATIVES TO CCA ..... ERROR! BOOKMARK NOT DEFINED.

7.1 CHEMICAL ALTERNATIVES TO CCA ..... **ERROR! BOOKMARK NOT DEFINED.**
7.2 PHYSICAL ALTERNATIVES ..... **ERROR! BOOKMARK NOT DEFINED.**
7.3 INDUSTRY RESPONSES ..... **ERROR! BOOKMARK NOT DEFINED.**

8 CONCLUSIONS AND RECOMMENDATIONS ..... ERROR! BOOKMARK NOT DEFINED.

REFERENCES **44**

4 WASTE OPTIONS

The eventual disposal of CCA-treated timber is of great concern to many stakeholders, due to the volume of anticipated waste and the lack of safe disposal options, given the toxicity of the treated timber. If CCA-treated timber is burned the smoke and the ash can be toxic (APVMA, 2003e: 6), so it is usually disposed of in municipal landfills where it continues to leach arsenic. In the US, material that leaches arsenic is classified as a hazardous waste and cannot be disposed of in municipal landfills. However, CCA-treated timber has been granted an exemption (Sharp & Walker, 2001: 11).

According to academics at the University of Florida, the exemption in the US was due to CCA involving pentavalent arsenic—a less toxic species of arsenic—and the presumption that the leaching mainly occurred with newly-treated timber. However, recent research on timber weathered for over ten years has found that the pentavalent arsenic is somehow converting to the 'highly toxic' trivalent arsenic, in volumes well over the limit for non-hazardous waste. In addition, it is surmised that as the timber's lignin decomposes, large quantities of arsenic are released from the older wood (Fauteux, 2003). Another study in the Journal of Hazardous Wastes has found that arsenic leaching from CCA-treated timber waste disposed of in landfills "is a major concern from a disposal point of view with respect to ground water quality" (Townsend, 2004).

Similarly, in the UK the requirements for safe disposal of hazardous waste now also apply to waste CCA-treated timber so as to prevent air and other polluting emissions (DEFRA, 2003). In Europe discarded CCA-treated timber has been classified as a hazardous waste since 2000 (Commission of the European Communities, 2003: 9). This was after the CSTEE raised concerns about the disposal of treated-timber in landfills: 'The CSTEE wishes to underline that a major source of concern regarding the use of arsenic-containing wood preservatives relates to the high degree of uncertainty regarding the speciation of arsenic during its long-term storage in landfills (the major points of arsenic accumulation), making reliable quantitative predictions about its migration and bioavailability extremely difficult. This is a serious knowledge gap which the CSTEE recommends should be addressed by further research. In the meantime, it would be advisable to exercise caution by limiting the use of arsenic-based wood preservation to those situations where it is absolutely necessary' (CSTEE 1998).

In Australia, CCA-treated timber waste is not classified as hazardous waste and there is a lack of clear information about how this waste should be disposed. Currently, CCA-treated timber is accepted at the discretion of the landfill operator in NSW, South Australia and Victoria (Smith and Mollah, 2004) and is often collected with other municipal waste. In NSW, CCA-treated timber is a priority waste (although a priority 2 waste rather than a priority 1 waste) on the Extended Producer Responsibility list but it is still accepted at a number of municipal landfill locations (Mitchell, S., NSW Department of Environment and Conservation, *Pers. Comm.*, 15/11/04). In Victoria, "product stewardship agreements on waste avoidance and recovery" will not be established for treated timber till 2009/10 (Ecocycle Victoria, 2003: 17).

Waste Services NSW, which operates 4 landfills and 7 transfer stations, could not provide adequate advice on the customer information line to this researcher as to whether treated timber is a hazardous waste and whether it could be disposed of at any of its four landfill sites (Waste Services NSW, Customer Enquiries, *Pers. Comm.*, 15/11/04). However the Waste Services website stated that no treated timbers would be accepted by Waste Services, as timber waste was reused for chipping for landscape mulches and as biofuel (Waste Services NSW, 2004).

4.1 Volumes

The scale of the waste-treated timber is enormous, particularly if existing CCA-treated timber structures are to be replaced by safer alternatives, as this report recommends. However there are already large amounts of waste CCA-treated timber being produced annually in Australia and overseas. A major source of this is the wine industry.

In 1999, a report prepared for the South Australian Environmental Protection Authority (EPA) found that wineries were the largest purchasers of preservative CCA-treated timber in South Australia. They estimated that 75% of the approximate 60 to 120 million vineyard stakes were made from CCA-treated timber. The SA EPA has found the growth of the wine industry has paralleled the increase in CCA timber manufacture. Since annual stake damage is around 15%, it is anticipated that in 2024, a peak volume of between 8 and 16 million posts will require disposal (cited in Smith and Mollah, 2004). There are already 816,000 posts stockpiled (Bell, 2005). The South Australian EPA warns that a toxic disposal crisis is looming, with 'no acceptable disposal option for CCA' in SA and no life cycle management for the heavy metals in the CCA. One way of easing the waste problem would be to encourage the wine industry to change its material choice for vineyard stakes. (Scott, 2004).

A treated timber disposal crisis is already being experienced in California. San Joaquin grape-growers turned to other crops after several difficult seasons, and removed thousands of tonnes of CCA-treated stakes. They are not permitted to burn these due to air pollution risks, and disposal to a landfill is not only costly but brings with it the 'lifetime liability', as disposer identities are logged and they can be held responsible in the event of ensuing problems at the landfill site (Pollock, 2004).

Matthew Warken (2004: 44) notes in his Masters thesis on wood waste in Sydney that "there would still be treated timber in the waste stream for the next 10 – 25 years, even if CCA treatment was banned today".

4.2 Incineration

Combustion of CCA treated timber involves a number of environmental hazards. Ash from CCA-treated timber contains elevated levels of heavy metals. Once burnt, the ash continues to leach heavy metals. Solo-Gabriele *et al* (2003a) confirmed CCA-treated wood ash exceeded the 5 mg/L regulatory level for total arsenic leaching under the US EPA standards. The CSIRO warns that the ash from burnt CCA-treated timber on rural properties should be removed or buried away from stock, as the 'salty contaminated ash … can cause problems' (CSIRO, 2005). The smoke can also contains high levels of arsine gas and dioxins: 'Studies show that, depending on the combustion conditions, 10-90% of the arsenic present in CCA-treated wood' may go up in the smoke (APVMA, 2003a: 47).

Australian research by Tame *et al* (2003), has tested ash from burnt CCA-treated pine for polychlorinated dioxins (dibenzo-p-dioxins) and furans (polychlorinated dibenzofurans, PCDD/F), well-known atmospheric pollutants. They concluded that these pollutants formed mainly during the smouldering of the char (ash), raising concerns about the impacts after bushfires in residential areas, such as Canberra during 2002. In Canberra 55 sites were contaminated with treated timber ash. Site remediation required removal of 2000 tons of soil, took a year to complete and cost around $3,000,000 (Godson, W. *Pers. Comm*., 27/2/05)

The APVMA review recognised the risks associated with incineration and warned that it 'should only occur in very controlled facilities where release of arsenic to the atmosphere is minimised and the potentially highly toxic ash is processed and disposed of appropriately.' For this reason the authority recommends that CCA chemical labels be varied to prevent waste CCA-treated timber

from being incinerated (APVMA, 2003a, p.47). However because of its limited powers the APVMA is not able to regulate potential incineration, although it could have made recommendations on this.

Incineration of CCA-treated timber is in fact banned in some states including NSW. EPA Victoria (2003) has raised concerns about horticulturalists who burn waste such as CCA-treated timber and has fined at least one grapegrower in 2003 for this because of the 'significant risk to human health, the environment and the clean green image…' The South Australian EPA warns that 'Children, pets and farm animals should be excluded from land where CCA ash is present [for example after bushfires]. Animals will want to lick or eat the salty residue and young children, especially those under 5 years, are at high risk from personal contact and ingestion. Animal deaths from ingesting ash have previously been reported on farms in the USA and UK' (SA EPA, 2005).

CCA-treated timber may be incinerated accidentally as a result of house fires and bushfires, or by people ignorant of its dangers when they dispose of waste treated timber in backyard burn-offs. People can also put treated timber into garbage streams that go to municipal incinerators. Fire-fighting organizations such as the country fire services are aware of the hazards associated with burning CCA but seldom know, when they attend a fire, whether the burning timber is CCA.

Perhaps of most concern is the fact that people sometimes burn it in their indoor home fireplaces, without realizing the dangers that they are exposing their families and neighbours to. Because traditional sources of heating wood are becoming scarce and therefore more expensive, scrap timber and off-cuts from building sites are turned to as free sources of timber. 'It is not uncommon to see this rubbish wood, including treated pine etc, piled high in Canberra backyards… not only treated pine but other treated timbers' (Darryl Johnston, *Pers. Comm.* 1/8/03).

CCA-treated timber may also be incinerated when it is mixed with other wood that is used as fuel wood. Often waste wood piles contain some CCA-treated wood, so that it would be hazardous to use them for fuel. Previous research found that 'visual sorting', based on the colour of the treated timber, is not accurate. To prevent the ash being classified as hazardous in the US, wood reused for fuel must contain less than five percent of CCA-treated timber (Solo-Gabriele, *et al*, 2001).

A more specific method for identifying CCA-treated timber is through a stain test. Although this is a workable method, the cost and time required to administer the stain were of particular concern to large recycling facilities. Solo-Gabriele *et al* (2001) claim that the Laser Induced Breakdown Spectroscopy (LIBS) and X-ray Fluorescence Spectroscopy (XRF) that they are developing will provide a faster and cheaper method for sorting waste wood. However both technologies have technological drawbacks and are not ready for commercial use. A trial of a portable hand held X ray device called a XRF metal analyser is being used at Medley USA.

Some research into safer controlled incineration methods that would capture the arsenic and toxic residues has begun but it is in its early states. At the University of Sydney's Chemical Engineering laboratories, research is underway into the possibilities of incinerating CCA-treated timber to recover both the energy as well as the metals (as environmentally stable residues). So far, the researchers have found that at temperatures greater than 400°C the copper and chrome are contained in the ash, while the arsenic is volatilized. The researchers are aiming to recover all three metal components from the waste wood (Stewart *et al*, 2004).

In earlier work undertaken at the University of Sydney for the Western Sydney Waste Board, it was found that at a combustion temperature of 900^{o}C, energy was more efficiently produced than in pyrolysis and gasification at lower temperatures, and arsenic (present as arsenate) was produced in a stable form. The researchers noted that the arsenic produced as off-gas was a concern, although if

combusted in a flash smelter such as those used in the copper industry, the arsenic could probably be captured (CRESTA, 2000). Solo-Gabriele *et al* (2001) report that in Europe pyrolysis technology appears to be further advanced, with 'two full-scale pyrolysis operations' in France which claim to recover most of the heavy metals.

4.3 Reuse

A UK analysis of treated wood waste streams found that the 'Best Practicable Environmental Option' is reuse, findings that are consistent with the principals of the waste hierarchy employed both in the UK and Australia. (Not producing the waste in the first place, is of course preferable.) However, the researchers did note that reuse markets for wood waste are limited and the value of the waste is low. Additionally, the quality of the wood waste and the risk of contamination were also cited as barriers to this option (Enviros Consulting *et al*, 2004). Similar research from the US found that up to 86 percent of CCA-treated timber from residential decks could be recovered for reuse (Smith *et al*, 2004). Yet in practice it has been found that parks and recreation facilities, in Florida at least, are concerned about the structural integrity of used CCA-treated timber, and prefer not to use it (Solo-Gabriele *et al*, 2000).

However, whilst reuse may deal with the waste disposal problem, it can exacerbate the health and environmental problems associated with the use of CCA-treated timber because it prolongs that use. In Florida, waste CCA-treated timber was prohibited from co-generation plants because of the resulting heavy metals in the ash but the waste was then diverted to mulch production, raising the risk to soil and groundwater through leaching (Solo-Gabriele, *et al*, 2001). Leachate from mulch manufactured from construction and demolition waste, which often contains waste CCA-treated timber failed water quality standards set by the US EPA (Townsend *et al*, 2001). And although the CSIRO highlights the potential use of CCA-treated timber as garden edging and fence posts, it warns against use of CCA-treated products being reused in mulch, animal bedding, beehives' as well as food chopping boards and boxes used to store or transport food (CSIRO 2005).

Researchers at Michigan State University have investigated the use of CCA-treated timber fibres in wood-cement particle composites. The resulting composite was found to have comparable strength to normal concrete and to withstand strains at peak load that are ten fold greater than normal concrete. This led the researchers to propose this material for use in energy dissipation applications (Gong *et al*, 2004).

USDA Forest Products researchers have found that oxalic acid extraction and bioleaching with a metal-tolerant bacterium can successfully remove up to 78 percent of copper, 97 percent of arsenic and all chromium from CCA-treated pine, which can then be recovered for reuse or disposal. It is noted that this remediation is currently 'cost prohibitive', but could become financially viable if landfill restrictions are imposed (Clausen and Kenealy, 2004).

Researchers from the USDA Forest Service have developed a metal-tolerant wood decay fungi to degrade waste CCA-treated timber (Illman *et al*, 2004). This reduces the volume of waste rather than reusing it.

REFERENCES

Anon, (2004), 'Playground Poison', *The New York Post*, August 15.

ABC (2004), 'AWU alert on CCA-treated timber', *ABC Country News Network*, http://www.abc.net.au

Andorno, R. (2004), 'The precautionary principle: a new legal standard for a technological age', Journal of International Biotechnology Law 1, pp. 11-19.

APVMA (2003a), *The Reconsideration Of Registrations Of Arsenic Timber Treatment Products (CCA And Arsenic Trioxide) And Their Associated Labels (Review Summary)*, Australian Pesticides And Veterinary Medicines Authority, Canberra. http://www.apvma.gov.au/chemrev/arsenic_draft_review.pdf

APVMA (2003b), *The Reconsideration Of Registrations Of Arsenic Timber Treatment Products (CCA And Arsenic Trioxide) And Their Associated Labels (Technical Report)*, Australian Pesticides And Veterinary Medicines Authority, Canberra. http://www.apvma.gov.au/chemrev/arsenic_tech_report.pdf

APVMA (2003c), Media Release - Draft Report on Arsenic Treated Timber Released for Public Comment, Australian Pesticides & Veterinary Medicines Authority, December 22, Canberra, http://www.apvma.gov.au/media/mr0310.shtml (accessed 22/10/04).

APVMA (2003d), Media Release - Copper Chrome Arsenate (CCA) - APVMA puts industry on notice, July 28, Australian Pesticides & Veterinary Medicines Authority, http://www.apvma.gov.au/media/mr0306.shtml (accessed 22/10/04).

APVMA (2003e) Arsenic Timber Treatments (CCA and Arsenic Trioxide): Review Scope Document. Canberra: Australian Pesticides and Veterinary Medicines Authority, Canberra, March. http://www.apvma.gov.au/chemrev/arsenic_scope.pdf

AWU (2004), National Hazard Alert and Ban: Usage of Copper Chrome Arsenate (CCA) treated timber, Australian Workers' Union, 15 September.

Auspine (2004), *ChemAlert: CCA Treated Plantation Softwood'*, Material Safety Data Sheet, http://www.auspine.com.au (accessed 1/11/04).

Beane Freeman, L., Dennis, L., Lynch, C., Thorne, P. and Just, C. (2004), 'Toenail Arsenic Content and Cutaneous Melanoma in Iowa', *American Journal of Epidemiology*, 160(7):679-687.

Beder, S. (1999), 'The Political Nature of Standard Setting', *Engineers Australia*, July: p. 62. http://www.uow.edu.au/arts/sts/sbeder/columns/engcol16.html

Bell, F. (2005), 'Managing Treated Timber Vine Posts', paper present to 3rd Australian Wine Industry Environment Conference, Adelaide, February.

Belluck, D., Benjamin, S., Baveye, P., Sampson, J., and Johnson, B. (2003), 'Widespread Arsenic Contamination of Soils in Residential Areas and Public Spaces: An Emerging Regulatory or Medical Crisis?', *International Journal of Toxicology*, 22, pp. 109:128.

Carruthers, P. (2002) 'The CCA Question: What Should We Do?' *The Treatment* 8 August.

Clausen, C. and Kenealy, W., (2004), 'Scaled-Up Remediation Of CCA-Treated Wood', Topic 1: Release of Preservatives into the Environment, Conference Paper from *Environmental Impacts Of Preservative-Treated Wood Conference*, February 8-11, Orlando, Florida.

Commission of the European Communities (2003), 'Commission Directive 2003/2/Ec of 6 January 2003 Relating to Restrictions on the Marketing and Use of Arsenic.' *Official Journal of the European Communities* L (4). 9 January.

Connell, M. (2004), 'Issues Facing Preservative Suppliers In A Changing Market For Treated Wood', Paper presented to *COST Action E22: Environmental Optimisation of Wood Protection*, Lisboa œ Portugal, 22- 23 March.

CPSC (2003a), *Fact Sheet: Chromated Copper Arsenate (CCA) -Treated Wood Used in Playground Equipment*, U.S. Consumer Product Safety Commission, February 7, http://www.cpsc.gov (accessed 16/8/04)

CPSC (2003b), *Briefing Package: Petition to Ban Chromated Copper Arsenate (CCA)-Treated Wood in Playground Equipment* (Petition Hp 01-3). Washington, DC: US Consumer Product Safety Commission (CPSC). February.

CRESTA (2000), *Copper chrome arsenate* (CCA) *Wood Waste: Review of Thermal Options for CCA Wood Waste Management*, Centre for Risk, Environment and Systems Technology and Analysis, Department of Chemical Engineering, University of Sydney, Sydney.

Croydon Conservation Society (2003), 'High levels of Arsenic, Chromium and Copper found on the surface of CCA treated timber used to build a children's playground', *Press Release*, Croydon Conservation Society, June 10.

CSIRO (2003), 'Wood Protection', Commonwealth Scientific and Industrial Research Organisation website, http://www.ffp.csiro.au/wft/wpc (accessed 21/4/04).

CSIRO (2004), *CSIRO Annual Report 2003/04*, Commonwealth Scientific and Industrial Research Organisation, Canberra.

CSIRO (2005), 'Safety of timber treated with CCA preservative', *Commonwealth Scientific and Industrial Research Organisation- Forestry and Forest Products website*, http://www.ffp.csiro.au/wft/wpc/ccafact1.html (accessed 23/2/05).

CSTEE (Scientific Committee on Toxicity, Ecotoxicity and the Environment) (2003), 'Commission Directive 2003/2/EC of 6 January 2003 relating to restrictions on the marketing and use of arsenic (tenth adaptation to technical progress to Council Directive 76/769/EEC)', *Official Journal of the European Communities*, January 9, L 4/9.

CSTEE (Scientific Committee on Toxicity, Ecotoxicity and the Environment) (1998), 'Opinion on the Report by WS Atkins International Ltd (Vol. B) "Assessment of the Risks to Health and to the Environment of Arsenic in Wood Preservatives and of the Effects of Further Restrictions on Its Marketing and Use" Expressed at the 5th CSTEE Plenary Meeting.' Brussels: European Commission (EC). 15 September.

DEFRA (2003), *Consultation on the transposition of the 10th adaptation to technical progress of Annex I to Council Directive 76/769/EEC relating to restrictions on the marketing and use of arsenic in England, Scotland and Wales (Great Britain)*, August, Department for Environment, Food and Rural Affairs, Great Britain.

Ecocycle Victoria (2003), 'Towards Zero Waste: A Solid Industrial Waste Management Plan for Victoria', Draft, March. http://www.ecorecycle.vic.gov.au/asset/1/upload/TZW_-_Towards_Zero_Waste_Full_Version_Draft_Solid_Industrial_Waste_Management_Plan_(2003).pdf

EHN Online (2004), 'Timber firm exposed employees to pesticides', *Environmental Health News Online*, http://www.ehn-online.com/cgi-bin/news/legals/epavafeyzuucodpohu.html September 23 (accessed 25/10/04).

EnHealth (2004), 'What is enHealth?', *enHealth website*, http://enhealth.nphp.gov.au/what_enh.htm (accessed 8/11/04).

Enviros Consulting and The BioComposites Centre, University of Wales (2004), Treated Wood Waste: Assessment of the Waste Management Challenge, The Waste & Resources Action Programme (WRAP), UK.

EPA Victoria (2003), 'Horticultural waste burning continues to cause concern', Media Release, 9 July.

Fauteux, A. (2003), 'Treated wood more toxic as it ages', *La Presse*, Montreal, May 17. p.A8.

Feldman, Jay (2002), *Letter to US EPA: Beyond Pesticides Comments on CCA-Treated Wood*, Beyond Pesticides website, March 22, http://www.beyondpesticides.org/wood/alerts/CCA_comments.htm (accessed 6/12/04)

Gong, A., Kamdem, D., and Harichandran, R. (2004), 'Compression Tests On Wood-Cement Particle Composites Made Of CCA-Treated Wood Removed From Service', *Environmental Impacts Of Preservative-Treated Wood Conference*, February 8-11, 2004, Orlando, Florida.

Gray, S. and Houlihan, J. (2002), *All Hands on Deck*, Washington, D.C.: Environmental Working Group (EWG). August. http://www.ewg.org/reports/allhandsondeck/AllHandsOnDeck.pdf

Greaves, H. (2003), *The Australian Timber Industry and CCA-Treated Timber Products*, The Timber Preservers Association of Australia (TPAA), Moorabbin, Vic., 3 March. http://www.ptaa.com.au/TPAAccafactsheet.pdf

Hauserman, J. (2001), 'The Poison in Your Back Yard.' *St. Petersburg Times*. 11 March.

Hogg, R. (2004), Letter to Peter Cobham, Koppers Arch Wood Protection (Australia) from Manager of Pesticides Revierw, APVMA, August 13. http://www.tanalised.com/files/pdf/TreatmentN_Letter.pdf

Illman, B. and Yang, V. (2004), 'Bioremediation And Degradation Of CCA-Treated Wood Waste', *Environmental Impacts Of Preservative-Treated Wood Conference*, February 8-11, 2004, Orlando, Florida.

Jolly Jumbuk (2000), *Jolly Jumbuk Log Playgrounds: Home Adventure Range* (Promotional pamphlet), Bondi, NSW.

Kaltreider, R., Davis, A., Lariviere, J-P, and Hamilton, J. (2001), 'Arsenic Alters the Function of the Glucocorticoid Receptor as a Transcription Factor', *Environmental Health Perspectives*, 109: 245-251.

Kennedy, M. (2004), 'Depletion Of Copper-Based Preservatives From Pine Decking And Impacts On Soil-Dwelling Invertebrates', Topic 1: Release Of Preservatives Into The Environment, Conference Paper From *Environmental Impacts Of Preservative-Treated Wood Conference*, February 8-11, 2004, Orlando, Florida.

Koppers Arch (2002), *Tanalith CCA timber treatment- Materials Safety Data Sheet*, Koppers Arch, Sydney.

Koppers Arch (2003a). 'U.S. Consumer Product Safety Commission Report.' Koppers Arch Wood Protection, http://www.tanalised.com/news.asp?content_id=101&id=12 (accessed 21/4/04).

Koppers Arch (2003b) 'CCA and the Alternatives.' Koppers Arch Wood Protection, http://www.tanalised.com/files/pdf/KACCA-Alt-Pos2003.pdf (accessed 21/4/04).

Koppers Arch (2004), 'APVMA finally delivers on CCA' and 'UK copes with CCA deadline', *Treatment Business News*, September, Issue 6, p.1, http://www.tanalised.com/files/pdf/TreatmentN_Letter.pdf

Kwon, E., Zhang, H., Wang, Z., Jhangri, G., Lu, X., Fok, N., Gabos, S., Li, X-F, and Le, X. (2004), 'Arsenic on the Hands of Children after Playing in Playgrounds', *Environmental Health Perspectives*, 112:1375–1380.

Lebow, S., Foster, D. and Evans, J. (2004a), 'Long-Term Soil Accumulation of Chromium, Copper and Arsenic Adjacent to Preservative-Treated Wood', *Bulletin of Environmental Contamination and Toxicology*, 72: 225-232.

Lebow, S. (2004b), 'Alternatives to Chromated Copper Arsenate (CCA) for Residential Construction', *Environmental Impacts Of Preservative-Treated Wood Conference*, February 8-11, 2004, Orlando, Florida.

Lebow, S., Williams, R. and Lebow, P. (2003), 'Effect Of Simulated Rainfall And Weathering On Release Of Preservative Elements From CCA Treated Wood'. *Environmental Science & Technology* 38 (Sept. 15): 4077-4082.

Lee, D-H, Son, D-W, Lee, M, and Kang, C (2003), Biological Safety Evaluation Of Animal Contact Of Preservative-Treated Wood, *International Research Group*, 34th Annual Meeting, Brisbane, Australia, 18-23 May.

Lerche Davis (2003), 'Carcinogens in Playsets, Decks, Picnic Tables', *WebMD Medical News*, November 14, http://my.webmd.com/content/article/77/90361.htm?z=3734_00000_1000_ts_02

Lewis, E. (2005), 'Kerr-McGee, Duryea firm named in class-action suit', *The Citizens Voice*, 5 January.

Loveridge, K. (2004a), *Correspondence- CCA: Correspondence between Keith Loveridge and EnHealth, EPA Victoria, APVMA, and Victorian Ministers, 2002- 2004*, Provided by Keith Loveridge (11/1/04).

Loveridge, K. (2004b), *Letter to Premier Steve Bracks*, April 11.

McArdle, E. (2002), 'Arsenic-Treated Lumbr may be Next Wave of Litigation', *Lawyers Weekly USA*, 14 October, http://www.lawyersweeklyusa.com/alert/usa/lumber.htm.

Natali Jr., A., Chiafullo, L. and Valladares, R. (2003), 'CCA-Treated Wood Litigation and Insurance Coverage Issues', *Mealey's Insurance Reports.*

National Environment Protection Council (1999). National Environment Protection (Assessment of Site Contamination) Measure: Schedule B(1) Guideline on the Investigation Levels for Soil and Groundwater. http://www.ephc.gov.au/nepms/cs/con_sites.html

NSW EPA (2004a), *Environmental Compliance Report: Wood Preservation Industry: Part C, Final Report*, NSW Environment Protection Authority, December.

NSW DEC (2004b), *Extended Producer Responsibility Priority Statement*, NSW Department of Environment and Conservation, http://www.epa.nsw.gov.au/resources/eprps2004.pdf (accessed 22/11/04).

NSW EPA (2003a), *Environmental Compliance Report- Wood Preservation Industry: Part A, Compliance Audit*, NSW Environment Protection Authority, June.

NSW EPA (2003b), *Environmental Compliance Report- Wood Preservation Industry: Part B: Review of Best Practice and Regulation*, NSW Environment Protection Authority, June)

NSW EPA (2003c), *Questions and answers on the wood preservation industry*, NSW Environmental Protection Authority website, http://www.environment.nsw.gov.au/licensing/qaswood.htm (accessed 1/11/04).

OEHAS (1999), *Hazards of Short-Term Exposure to Arsenic Contaminated Soil*, Office of Environmental Health Assessment Services, Washington, USA.

Office of Pesticide Programs (2002a). 'Manufacturers to Use New Wood Preservatives, Replacing Most Residential Uses of CCA.' US Environmental Protection Agency (EPA). 12 February.

Office of Pesticide Programs (2002b). 'Questions & Answers: What You Need to Know About Wood Pressure Treated with Chromated Copper Arsenate (CCA).' US Environmental Protection Agency (EPA). 12 February. http://www.epa.gov/pesticides/citizens/cca_qa.htm.

Osmose (2004), 'APVMA Review of CCA', *Osmose News, August*, *http://www.osmose.com.au/News/CCAReview.html*

Pianin, E. (2002), 'Arsenic to Be Banned in Home Lumber.' *San Francisco Chronicle*. 13 February, p. A-3.

PineSolutions (2000), 'CCA Treated Plantation Pine', *Material Safety Data Sheet*, http://www.pinesolutions.com.au/products/MSDS/downloads/cca_treatedpine.pdf (accessed 1/11/04).

Pollock, D. (2004), 'Arsenic and Old Stakes: Too dangerous to burn or bury, treated wooden grape stakes sit in piles of thousands', *FresnoBee.com*, California, October 10.

Robinson, B. Greven, M., Sivakumaran, S., Green, S. and Clothier, B. (2004), *Results of an initial survey of the leaching from treated posts in vineyards in the Marlborough region*, Horticulture and Food Research Institute of NZ Ltd for the Marlborough District Council, New Zealand, May.

Rouse, A. (2004a), *WWF Submission on the Draft for draft Australian Standard (DR 03476 – 3481): Guide to the Safe Use of Preservative-Treated Timber*, Worldwide Fund for Nature (Australia), February 18.

Rouse, A. (2004b), *WWF Submission on the Australian Pesticides and Veterinary Medicines Authority Review: The Reconsideration of the Registrations of Arsenic Timber Treatment Products (CCA and arsenic trioxide) and Their Associated Labels*, Worldwide Fund for Nature, February 18.

SA EPA (2005), 'Public Health Danger: Ash from CCA-Treated Timber, Environmental Protection Authority, South Australia, 25 January, http://www.epa.sa.gov.au/timber.html

Scott, G. (2004), 'CCA Treated Timber: A Problem?', *WMAA Towards Zero Waste Conference*, Adelaide, Australia, April.

Sharp, R. and Walker, B. (2001), *Poisoned Playgrounds: Arsenic in 'Pressure-Treated' Wood*, Environmental Working Group and Healthy Building Network, Washington D.C. http://www.ewg.org/reports/poisonedplaygrounds/poisonedplaygrounds.pdf

Sharp, R. *et. al.* (2001), *The Poisonwood Rivals: High Levels Of Arsenic Found In Lumber From Home Depot & Lowe's*, Environmental Working Group and Healthy Building Network, Washington D.C. http://www.ewg.org/reports/poisonwoodrivals/poisonwood.pdf

Shiralipour, A. (2004), *Arsenic Uptake Released from CCA Treated Lumber by Florida Vegetable Crops*, Florida Center for Solid and Hazardous Waste Management.

Smith, B., Bailey, D., Araman, P. (2004), 'Characterizing Properties And Products Of Spent CCA From Residential Decks', Poster From The *Environmental Impacts Of Preservative-Treated Wood Conference*, February 8-11, 2004, Orlando, Florida.

Smith, T. And Mollah, M. (2004), 'CCA Review Implications For Viticulture', *The Australian & New Zealand Grapegrower And Winemaker*, Ryan Publications, April.

Solo-Gabriele, H., Durbin, M., Jacobi, G., Townsend, T., and Dubey, B. (2004), *Educational Outreach and Stain Distribution Project for Identifying Copper-Treated Wood* (Draft), Florida Center For Solid And Hazardous Waste Management, US.

Solo-Gabriele, H., Khan, B., Townsend, T., Song, J-K., Jambeck, J., Dubey, B., Yang, Y-C., Cai, Y. (2003a), 'Arsenic and Chromium Speciation of Leachates from CCA-Treated Wood', Florida Center For Solid And Hazardous Waste Management, Florida.

Solo-Gabriele, H., Townsend, T., Schert, J. (2003b), 'Environmental Impacts of CCA-Treated Wood: A Summary from Seven Years of Study Focusing on the U.S. Florida Environment, *International Research Group On Wood Preservation*, Brisbane, May 18-23.

Solo-Gabriele, H., Hosein, N., Jacobi, G., Townsend, T., Jambeck, J., Hahn, D., Moskal, T., Iida, K. (2001), *On-Line Sorting Technologies for CCA-Treated Wood*, Draft Submitted on September 30, for Sarasota County for Submission to the FDEP Innovative Recycling Grants Program.

Solo-Gabriele, H., Kormienko, M., Gary, K., Townsend, T., Tolaymat, T. (2000), *Alternative Chemicals and Improved Disposal-End Management Practices for CCA-treated Wood*, Florida Center For Solid And Hazardous Waste Management, Florida.

Standards Australia (2003), 'DR03476-03481: Draft for Public Comment'.

Standards Australia (2005a), 'TM-006 – Committee Constitution', https://committees.standards.org.au/COMMITTEES/TM-006/ORGANISATIONS/ (accessed 13/1/05)

Standards Australia (2005b), 'Meeting Reports', https://committees.standards.org.au/COMMITTEES/TM-006/MEETINGREPORTS/ (accessed 13/1/05)

Stewart, M., Rogers, J., Breed, A., Haynes, B. and Petrie, J. (2004), 'Deportment And Management Of Metals Produced During Combustion Of CCA-Treated Timbers', Poster From The *Environmental Impacts Of Preservative-Treated Wood Conference*, February 8-11, 2004, Orlando, Florida.

Stilwell. D., (1999) 'Arsenic in Pressure Treated Wood.' Department of Analytical Chemistry, Connecticut Agricultural Experiment Station. Accessed on 23 August 1999. http://www.state.ct.us/caes/arsenic99.htm

Stilwell, D., Toner, M., Sawhney, B. (2003), 'Dislodgeable copper, chromium and arsenic from CCA-treated wood surfaces', *The Science of the Total Environment*, accepted for publication, March 8.

Strömberg, L. (2003), 'Minimisation Of The Environmental Impacts Of Coatings On Exterior Wood By Optimisation Of Their Life Spans', *International Research Group On Wood Preservation 34*, Brisbane, May.

Suttie, E. D. (1997), 'Novel Wood Preservatives.' *Chemistry and Industry* 15 September, pp. 720-4.

Tame NW, Dlugogorski BZ, Kennedy EM.(2003) 'Assessing influence of experimental parameters on formation of PCDD/F from ash derived from fires of CCA-treated wood', *Environmental Science and Technology* 37(18): 4148-56.

The Centre for Treated Timber Information (2005), *Frequently Asked Questions*, Preserved Wood website, http://www.preservedwood.com.au/FAQ.php. Accessed 15/1/05.

Townsend, T., Stook, K., Ward, M., Solo-Gabrielle, H. (2003) 'Leaching And Toxicity Of CCA-Treated And Alternative-Treated Wood Products', *Florida Center For Solid And Hazardous Waste Management*, Report #02-4

Townsend, T., Stook, K., Tolaymat, T., Song, J., Solo-Gabriele, H., Hosein, N., and Khan, B. (2001), *New Lines of CCA-Treated Wood Research: In-Service and Disposal Issues*, Florida Center For Solid And Hazardous Waste Management, Florida.

Townsend, T., Tolaymat, T., Solo-Gabriele, H., Dubey, B., Stook, K., and Wadanambi, L., (2004), 'Leaching of CCA-treated wood: implications for waste disposal', Journal of Hazardous Materials 114(1-3): 75-91.

US EPA (2003), 'Effects Of Metal-Metal Interactions On Toxicokinetics Of Arsenic From CCA-contaminated Materials And Environmental Media (Soil, Dislodgeable Material)', *A Probabilistic Risk Assessment For Children Who Contact CCA-Treated Playsets And Decks*, Draft Preliminary Report, November 10,Pp 297—298.

US EPA (2004a), 'Guidance for Uses of Chromated Copper Arsenate (CCA), http://www.epa.gov (accessed 16/6/04).

US EPA (2004b), CCA Guidance- Questions and Answers, US Environmental Protection Agency website, http://www.epa.gov/pesticides/factsheets/chemicals (accessed 17/6/04).

WA DOCEP (2004), 'Termites and Your Home', *Department of Consumer and Employment Protection website, Western Australia*, August, http://www.docep.wa.gov.au (accessed 8/11/04).

Walker, J. (2004), Photo of Manuel Cunha Jr., President of Nisei Farmers League, California, to accompany article by Pollock, D. (2004), 'Arsenic and Old Stakes: Too dangerous to burn or bury, treated wooden grape stakes sit in piles of thousands', *FresnoBee*, California, October 10.

Warken, M. (2004), 'Optimal Recovery of Resources: A Case Study of Wood Waste in the Greater Sydney Region', Master of Engineering Research Thesis, Chemical Engineering, University of Sydney, March.

Waste Services NSW (2004), Waste Services website, http://www.wasteservice.nsw.gov.au (accessed 15/11/04).

Weis, J.S. and Weis, P. (2004), 'Effects of CCA Wood on Non-Target Aquatic Biota', Environmental Impacts of Preservative-Treated Wood Conference, Orlando, February http://www.ccaresearch.org/Pre-Conference/pdf/Weis.pdf

West, D. (2004), 'Health Effects Of Preserved Wood: Relationship Between CCA-Treated Wood And Incidence Of Cancer In The United States', Topic 3: Health Effects Of Preserved Wood, Conference Paper From *Environmental Impacts Of Preservative-Treated Wood Conference*, February 8-11, 2004, Orlando, Florida.

Whetzel, C. (2003), 'Firms Making Arsenic-Treated Products To Notify California Consumers of Risks', *BNA*, March 24, http://www.ewg.org/news/story.php?print_version=1&id=1529 (accessed 1/11/04)

Whinnett, E. (2003) 'Cancer Fear over Treated Pine,' *The Mercury*, 22 April, p. 7.