Report on
Investigation of a Contamination Risk
Resulting from Exposures to Arsenic and Chromium
from a
Chromated Copper Arsenate (CCA) Treated Wood Deck
in Ottawa, 2002

Sierra Club of Canada
July 2003

Introduction

In September 2002, the Sierra Club of Canada's (SCC) national office in Ottawa was contacted by a Ottawa-South resident complaining that a recently constructed wood deck behind her home had contaminated some family members and the pet dog with arsenic (As) and chromium (Cr). These toxic elements were believed to be exuding from the deck wood. The wood was purchased from a Home Depot store in Ottawa, Ontario and was treated by Trent Timber Treating in Peterborough, Ontario. CCA(Chromated Copper Arsenate) is pesticide compound used to pressure-treat wood to preserve it from rot, fungus and insect-caused deterioration.

ML, a women in her early forties and mother of TL, a 6 year old girl (referred as such in the text to protect their privacy) told SCC that she believed that she, her daughter and the family dog (which had just died) had been poisoned from As and Cr emitted from this wood during their use of the deck during the months of July and August 2002.

SCC Sampling and Analysis

Daniel Green, a scientific advisor to SCC, contacted ML to investigate her complaint, as SCC was concerned that the wood, if the source of contamination, might be affecting other purchasers and the environment.. On the 8th of October 2002, Mr Green met ML at her home in Ottawa-South and did an inspection on the deck. During this inspection, Mr Green saw greenish oozing resin materials coming out of knots and cracks from CCA treated wood rail posts, corner posts, floor and stair boards of the deck. The colour of this resin was indicative of oxides of copper; a component of CCA based pesticides. Following this visual inspection, Mr. Green took resin samples from the decks boards and posts and also took soil samples from the ground beneath the wood deck. Samples of pooled rainwater and pooled rain water saturated cotton swabs were collected by ML on October 4th after a rain event from the surface floorboards of the deck. These water samples were also given to Mr. Green. All these samples were taken by Mr. Green to the Caduceon Environmental Laboratories in Ottawa (a Canadian Ass. of Environmental Laboratories accredited Lab.) on the same day of sampling. Analysis for elemental As and Cr were performed and all the samples submitted.

Environment Canada- Home Depot Sampling and Analysis

Subsequent to the SCC sampling, Jacques Whitford Environmental Ltd. (JW) was hired by Home Depot in the following days to cut pieces of the deck wood. These spruce wood samples were sent to Paul Cooper, a professor of Wood Science at the Faculty of Forestry of the U. of Toronto for testing and analysis. The work performed by Prof. Cooper was paid for by Environment Canada.

In addition to all these deck samples taken, a piece of a scrap CCA treated jack pine wood (not part of the deck) was gathered by Environment Canada from under ML's wood deck and was sent to Prof. Cooper and to Environment-Canada's Environmental Protection Laboratories in Alberta for testing and analysis on the first week of October 2002.

Analysis Results

SCC asked Daniel Green to review all the analysis results of the three testing campaigns (SCC, Prof. Cooper and Environment Canada) in order to present a unified appreciation of all test performed on ML's CCA treated deck wood as compared to other CCA scrap wood (not part of the deck).

Figure 1 and 2 are diagrams of the deck showing the sampling points and the analysis results of SCC's and JW-Cooper sampling campaign respectively.

The highest concentrations of surface As and Cr were found in the resin on the surface of rail and corner posts (fig1, sample points A) and in a deck-board (fig. 2, sample point JW-4). These concentrations (in ug/g) are almost two orders of magnitude higher than the surface wipe test (given in ug/100 cm^2, fig. 2 sample JW 1 to 4 –wipe test) performed by Cooper on the deck wood samples. For As in resin the range was 2040 to 2300 ug/g vs. 9 to 30 ug/cm^2 and for Cr in resin the range was 2500 to 2827 ug/g vs. 25 to 9 ug/cm^2).

A comparison between CCA components between the two types of wood was done based on testing results from Cooper and Environment Canada. Figure 3 shows these results. The spruce wood from the deck (JW sample) compared to the jack pine (EC sample-not part of the deck,) show very little difference in CCA components in the treated margin of the two types of wood.

But when SCC did the same comparison between the As and Cr concentrations in the resin sampled by SCC and Cooper from the CCA spruce deck wood versus scrap CCA treated jack pine wood sample (not part of the deck) we found extremely large differences between the two types of wood. Figure 4 (data log transformed) shows that both SCC's and Cooper's As–Cr concentrations in resin from the deck's spruce wood are almost identical (SCC did not have the Cu levels in resin analysed) while As-Cr levels in resin from the Cooper-EC jack pine (not part of deck) are comparatively very low (As conc. (ug/g) deck spruce wood vs. jack pine: 1330-1499 vs. 6.52. Cr conc. (ug/g) deck spruce wood vs. jack pine: 1300-1470 vs. 119.6). Thus ML's deck spruce wood has 217 times more As and 11 times more Cr in its surface resin than the surface resin of the jack pine wood sample.

Analysis of pooled rainwater samples also yielded a high level of soluble As leaching from the deck. Figure 5 shows levels of CCA components in pooled rainwater on the deck and in water following extraction procedures (EP test) performed by Environment Canada on CCA treated jack pine sample (not part of deck). The passive leaching of As from the deck wood to rain water was measured at 2.05 mg /l compared to 1.5 mg As /l in water after the much more aggressive EP test (mulched wood mixed with acidic water) done on the jack pine. This seems to indicate that the CCA spruce wood used on the deck water less apt in retaining CCA components than the jack pine.

Discussion of the Results – Risk Assessment

This data leads SCC to believe that dermal contact with the surface resin and pooled water (from rain and from plant watering activities) from the deck wood, leading to subsequent dermal absorption and oral ingestion, could have given an adult or child user of this deck a dose of As or Cr that might be detrimental to health. To evaluate this, SCC applied various exposure scenarios to this As-Cr laden resin and water and computed various dose outcomes.

A complete exposure pathway analysis of this contamination event was done. Thus dermal, inhalation and incidental ingestion scenarios have been determined based on exposure activity patterns typical of the use of the deck in the summer of 2002, inclusive of wood dust exposures that might have occurred during the building of the deck. A preliminary calculation of exposures (dermal contact, inhalation and incidental ingestion) based on As/CR concentrations found in resin, in surface wood (wipe test), pooled water and wood dust found on the surface of section of the deck indicates that a As dose could have been received by the daughter that would be over the acute effect level dose (less than 120 days) for As based the latest ATSDR toxicology profile for As.

Biological samples (blood, hair, and urine) were taken from ML and her daughter and assayed for Cr and As from September 2002 to March 2003. This data, while contradictory at times, suggests there might have been some exposure to As and Cr exposure over time (August 2002 to January 2003). More work will have to done to better interpret this data to ascertain if the mother and daughter have indeed received a "biologically effective" dose of As/Cr from this deck.

Conclusion

SCC believes that the resin that has flowed from the spruce wood of the deck could be the major delivery matrix of As/Cr to ML and her daughter. This is supported our (SCC's) and by Dr. Cooper analysis of resin sample taken from the spruce wood deck samples.

Compared to the jack pine resin samples (another type of wood used might have been used for the deck) the concentrations of As/Cr are extremely high in the spruce resin.

These elevated As/Cr levels in resin coupled with the high adherence of resin to skin and higher leaching characteristics of resin compared to wood could all explain this exposure event.

There are many possible explanations on why this wood is so resinous and why readily available CCA has accumulated in the resin.

It may be because the wood preserver, Trent inc., decided to treat “green”, sappy spruce wood that could not "fixate" all the CCA. Thus, even if at first glance the CCA mass balance in the wood seems to be within the product standards, the woods resin content and condition may not have been optimal to be able to hold in all the CCA after treatment.

The high levels of As and Cr in the deck wood resin and in pooled rain water and the high occurrence of resin seeps on the surface of various parts of this deck leads SCC to conclude that the batch of pre-treatment spruce wood used by the wood treater Trent, may have been a very green and highly resinous wood. During the CCA pressure treatment process of this type wood, the CCA could have reacted with excess resin in this wood. After exposure to the sun, the CCA saturated resin leaked out of the cracks and knots of the deck wood and also became soluble in rainwater.

It is important to investigate if any more of this batch of CCA treated green spruce wood from Trent was sold by Home Depot in the spring- summer of 2002 to other Ottawa-area consumers for the construction of decks and other outside structures that might have caused, and might still be causing, exposures to As and Cr to users of these decks or other structures.

Daniel Green
for the Sierra Club of Canada
July, 2003

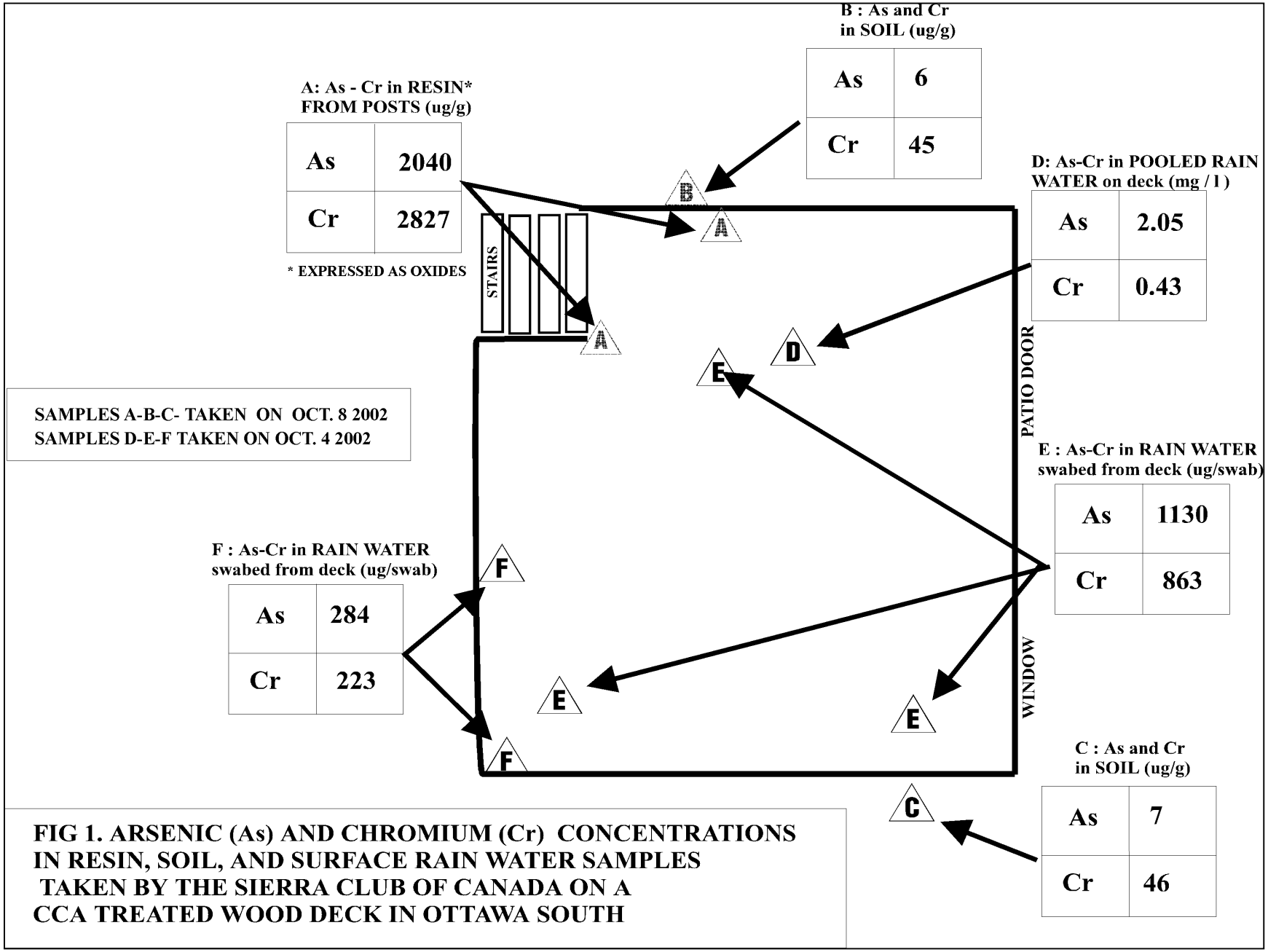


FIG 1. ARSENIC (As) AND CHROMIUM (Cr) CONCENTRATIONS IN RESIN, SOIL, AND SURFACE RAIN WATER SAMPLES TAKEN BY THE SIERRA CLUB OF CANADA ON A CCA TREATED WOOD DECK IN OTTAWA SOUTH

JW-3: As - Cr in WIPE TEST FROM A 5/4 " STAIR BOARD (ug/ 100 cm2)

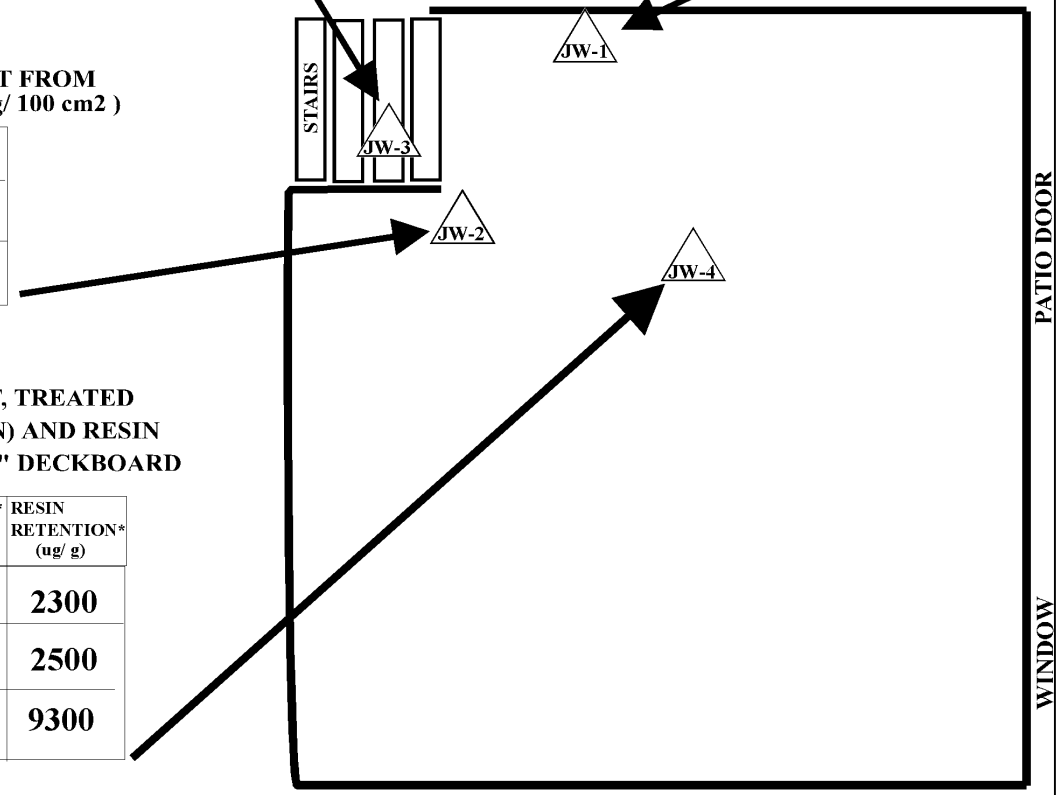
As	30
Cr	25
Cu	29

JW-1: As - Cr in WIPE TEST FROM A 2X2 VERTICAL POST (ug/ 100 cm2)

As	9
Cr	9
Cu	14

JW-2: As - Cr in WIPE TEST FROM A 4X4 VERTICAL POST (ug/ 100 cm2)

As	14
Cr	11
Cu	11



JW-4: As - Cr CONC. in WIPE TEST, TREATED WOOD SECT. (WOOD RETENTION) AND RESIN (RESIN RETENTION) FROM A 5/4" DECKBOARD

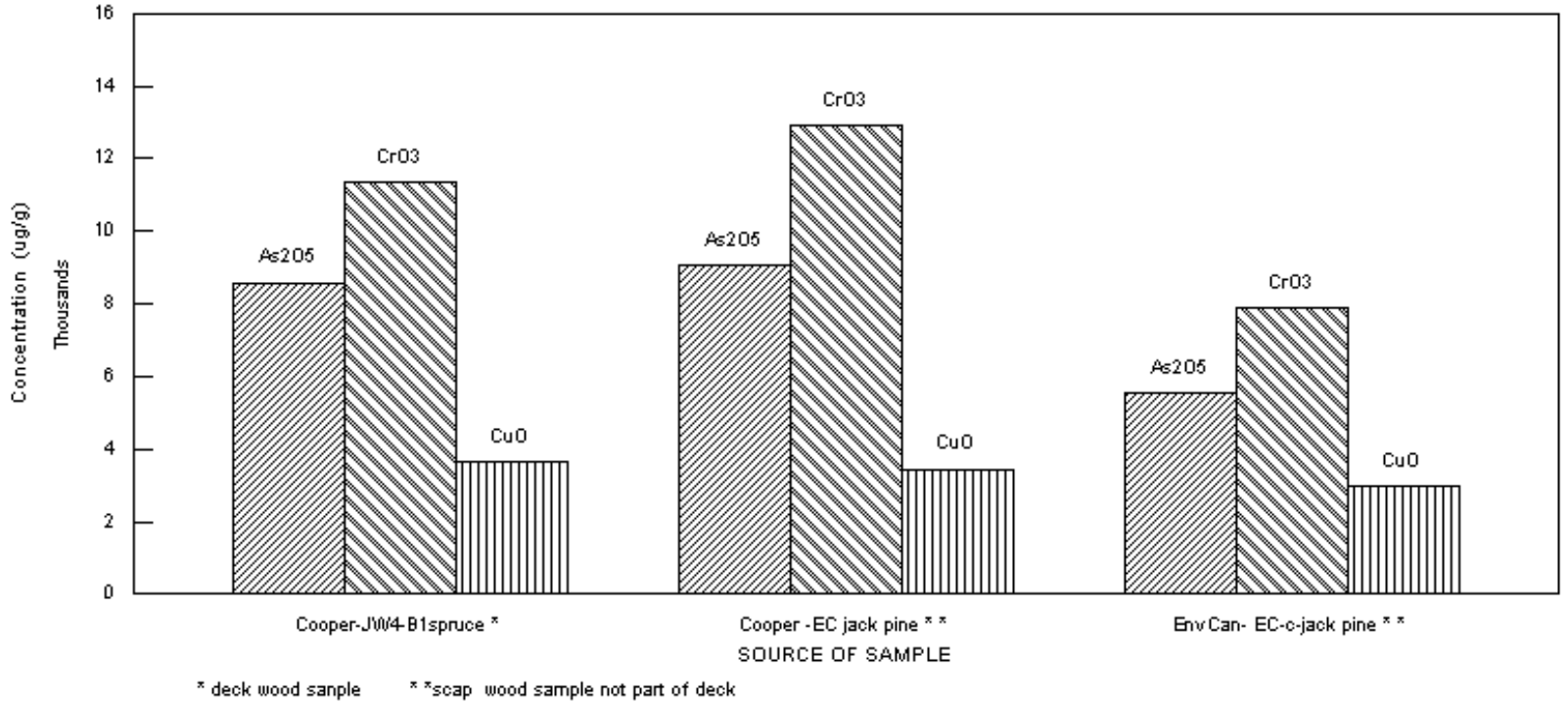
	WIPE TEST (ug/ 100 cm2)	WOOD RETENTION * kg/m3	mass balance (%)	RESIN RETENTION* (ug/ g)
As	1	3.0	36.2	2300
Cr	8	4.0	47.8	2500
Cu	80	1.3	15.4	9300

* EXPRESSED IN OXIDES

FIG 2. ARSENIC (As) AND CHROMIUM (Cr) CONCENTRATIONS (1) IN CCA TREATED DECKWOOD AND RESIN SAMPLES TAKEN BY JAQUES WHITFORD ENVIRONMENTAL LTD FOR HOME DEPOT FROM A SOUTH OTTAWA DECK IN OCTOBER 2002

(1) Evaluation of CCA treated deck samples from Ottawa deck, Oct.26 2002. Paul Cooper Ph.D. Wood Science Faculty of Forestry, University of Toronto

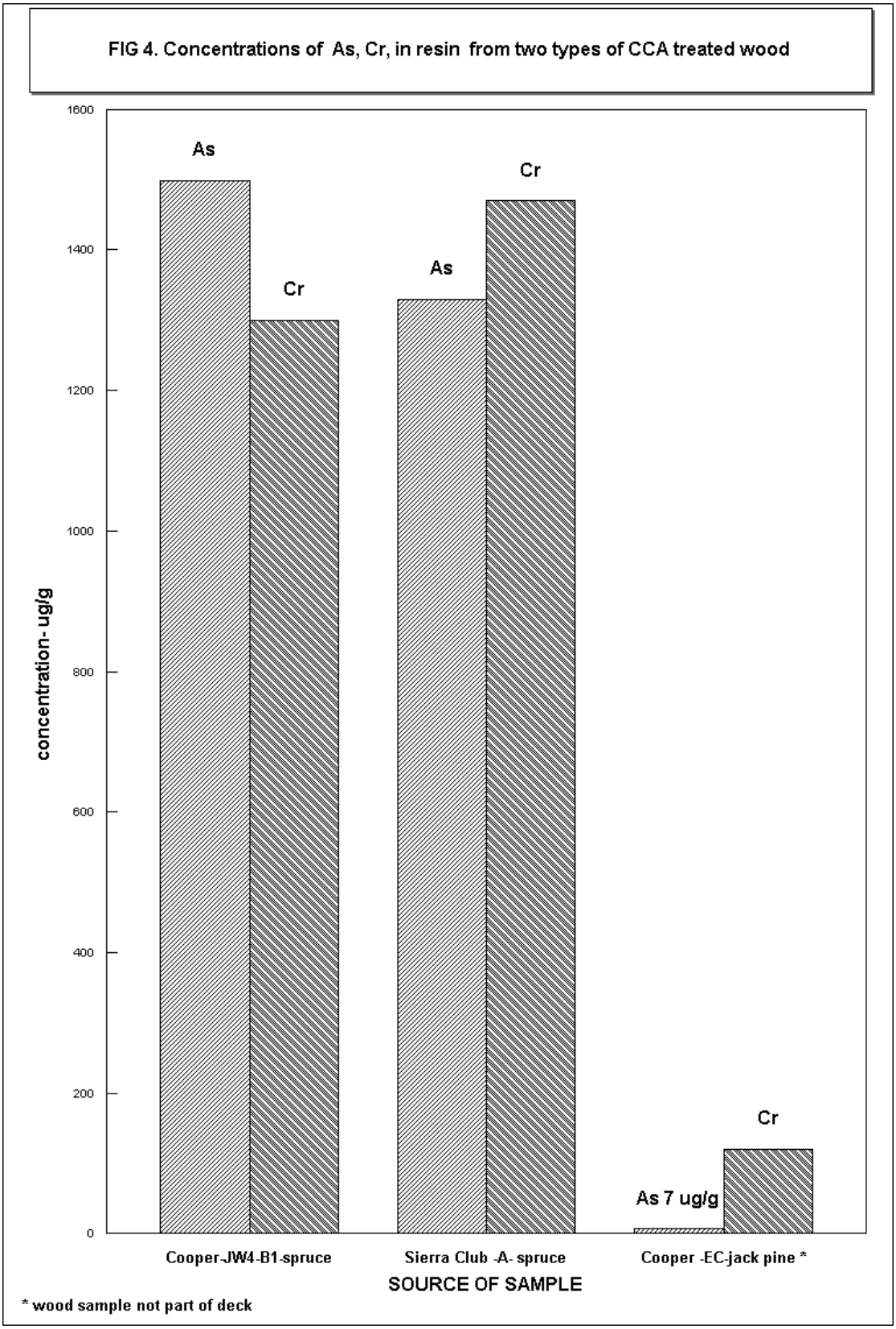
Fig. 3 : Concentrations of CCA components in the wood of a treated deck and in scrap wood samples (1, 2)



* deck wood sanple * *scap wood sample not part of deck

1- Evaluation of CCA treated deck samples from an Ottawa deck, Prof. Paul Cooper Faculty of Forestry, University of Toronto, October 26, 2002
2- Report of Analysis, Preserved Deck Wood , EP Laboratories, Environment Canada, to Barry Munson, EPB, Toxic Substances Division, Environment Canada , November 1, 2002

Figure 4: Comparison of As and Cr in resin from CCA treated spruce wood and jack pine.



Surface resin samples taken from CCA treated spruce wood cuttings of an Ottawa home wood deck by Dr. Cooper (dept. of Forestry, U. of Toronto) (Cooper-JW4-BI) deck and by the Sierra Club of Canada (Sierra Club -A-). These are compared to sampled resin from a CCA treated jack pine cutting (not part of the deck) submitted by Environment Canada. Theses results show that the resin from the CCA treated spruce deck wood contains a much higher arsenic and chromium concentration when compared to resin in a CCA treated jack pine cutting. CCA treated spruce deck wood surface resin contains arsenic levels that are 217 times the arsenic levels from in resin of CCA treated jack pine. The chromium in resin at the surface of the CCA treated spruce deck wood cuttings were 12 times higher then the chromium levels found in the resin of CCA treated jack pine. When this wood was used to build the Ottawa deck, exposure to the sun, summer heat, high humidity caused the CCA-laden resin to seep out of the spruce wood, creating surface CCA-resin pockets in the deck's planks and posts. From these resin pockets, resin containing high levels of arsenic and chromium oxides flowed on surfaces of the deck wood creating ideal dermal exposure conditions to sticky and highly contaminated resin for the users of this deck.

FIG5. Concentrations of As, Cr, Cu, in leachate tests (CCA jack pine)and pooled surface rain water from a CCA treated s