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PRESERVATIVE MOBILITY IN DECKING

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Introduction

Several studies have been done on the loss of chemical from chromated copper arsenate (CCA) treated wood in service (Choi et al., 2001, Evans 1987, Jin and Archer, 1991, Solo-Gabriele *et al.,* 2000, and Taylor and Cooper, 2003). Evans (1987) studied the leaching of CCA treated wood in service including roof shakes and silos. Recently, Choi *et al.* (2004) assessed the leaching of CCA decking and found that arsenic losses were particularly high and continued through the test duration, while chromium losses were very low. Also, a mathematical model was formulated to link the lost of arsenic with the environmental conditions of exposure. Comparisons of leaching of CCA to an alkaline copper quat (ACQ) preservative (ACQ type D) by Solo-Gabriele *et al.* (2000), observed similar percentages of chemicals leached. Nicholas *et al*. (1991) compared the leaching of copper in various ammoniacal formulations finding that ACQ had a lower loss of copper. The objective of this study is to examine the leaching of copper from preservative treated wood used as a decking exposed to the natural climatic conditions.

Methodology

Materials

To evaluate the leaching of copper from treated wood exposed above ground, samples of decking were obtained from CSI, Arch, and Dr. Wolman GmbH. Some additional ACQ treated samples were purchased from Home Depot in Vancouver. Twelve ACQ type C hem-fir (commercial mixture of western hemlock *Tsuga heterophylla* Raf. and *Amabilis fir* Forb.) treated boards (37.5 mm thick x 87.5 mm wide x 0.58 m long) provided by Chemicals Specialties Inc. (CSI) were used. Three different species of copper azole (CA-B) treated boards (3.8 cm thick x 14 cm wide x 122 cm long) provided by Arch Chemicals Inc. were used in the study: Jack Pine (P*inus banksiana*), hem-fir and Lodgepole pine *(Pinus contorta*). For copper-HDO (CX) treated wood both 38 mm thick x 87.5 mm wide and 38 mm thick x 140 mm wide samples treated to three target retentions were supplied and used.

Sample Preparation

The boards were cut in 28 cm. long sections. Three sections from 38 mm thick x 87.5 mm wide and two sections from 38 mm thick x 140 mm wide source boards were placed together on supports over a plastic container and exposed above ground. The exposure of the basins was considered to maximize sun hours and the direction of the rain in Vancouver (east-west).

Initial Measurements

Before the exposure, the copper penetration in each board was measured and the weight and moisture content at the surface of the samples were recorded. For the CSI ACQ treated boards, small cross sectional samples were removed from every each section as a reference sample. For all other material additional matched boards were available for analysis of the preservative retention.

Field Leaching

Each month, the weight and moisture content, of each sample were recorded and the volume and pH of the leachate was measured. A sample of the leachate was retained to analyze the copper by atomic absorption spectroscopy (AWPA A11-93-2002). The containers were washed with distilled water before being placed back in rest with the boards to continue the exposure.

Influence of the weather in the leaching of copper

For the ACQ since two years of data was available, a multivariable regression analysis was done to determine the relationship among the environmental conditions of the period of exposure and the amount of copper leached, using the statistical software SPSS, (SPSS Inc, Chicago).

Results and Discussions

Because the samples for the different treatments were placed in test at different times of year and in different years, it is not possible given the short exposure period to compare the depletion patterns for the different preservatives. The comparison is therefore made only of factors within each preservative system.

ACQ treated samples

The results for the depletion of the copper from the ACQ treated boards is shown in Figures 1 to 3. As can be seen the pattern of copper leaching (Figure 1) shows an initial loss during the first four months followed by a more gradual loss that appears to be cyclical. Following the drying out of the samples the subsequent wetting of the upper surface by rain causes a loss of copper which has migrated to the surface by diffusion. The loss of copper appears to be divided into two clear phases, the initial loss and the slower gradual loss of migrated copper. It is possible to relate the cumulative loss at any point with the initial loss (Figure 4). The results clearly show that a higher initial loss is related to a greater long term loss.

The influence of the environmental conditions on the field leaching of copper from amine copper treated wood is shown below for the ACQ after two years of exposure..

Cu leached(mg)=12.573-3.347*T*+0.003*V*+0.55*S*-0.923*Temp*

Where: T: time of exposure in months; V: volume of leachate (ml); S: sun hours; and Temp: Temperature

In agreement with the earlier research the loss of copper is related not only to the rainfall, but also the periods of sunshine and temperature. This impacts on the drying behaviour of the boards, and their ability to absorb rain during the initial period of wetting as well as the migration of moisture to the surface during drying.

Copper azole samples

Cumulative amounts of copper leached are shown in Figure 5. This data shows the importance of the preservative penetration and available copper content on the data. The lodgepole pine penetrations were the smallest so that the amount of available copper was also relatively small. Consequently even a very small amount of copper being leached caused a higher value when expressed as a percentage loss. When the data was expressed in terms of the amount of copper per unit upper board surface area (Figure 6) the expected trend is observed. The hem-fir is better treated and so has more available copper to migrate. In addition, the heartwood boards of pine have extractives which are able to chelate the copper and so minimize the loss.

CX samples

The CX sample have only been exposed for 6 months so this data is preliminary (Figure 7). The boards with lower retention do seem to be leaching less copper but the data is not consistent in this regard. Similarly as might be anticipate the “2 x 4” with the larger surface area is leaching more copper than the “2 x 6”, although again the differences are small. More work is needed to confirm this observation.

Pressure washing and water repellant ACQ treated decking samples

Based on the early observations, it was noted that if the early loss of copper could be reduced then the overall leaching could be significantly reduce. Two strategies regarding this were the use of a post treatment pressure wash of the samples and a brush application of a commercial retail water repellant treatment. The results are shown in Figure 8. The results clearly show the benefits available for the brush applied water repellant treatment.

References

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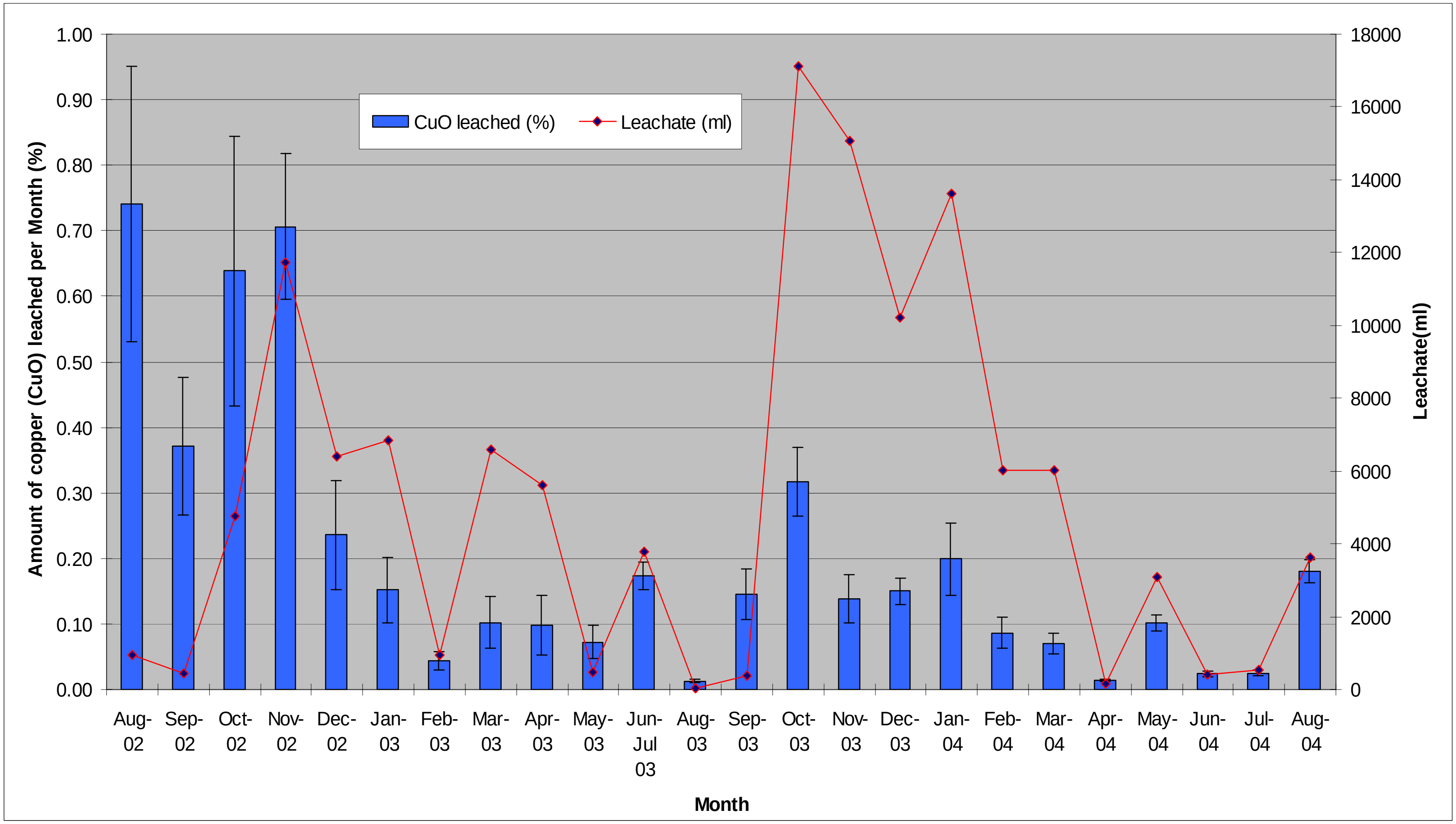

Figure 1. Depletion of copper from ACQ treated decking boards

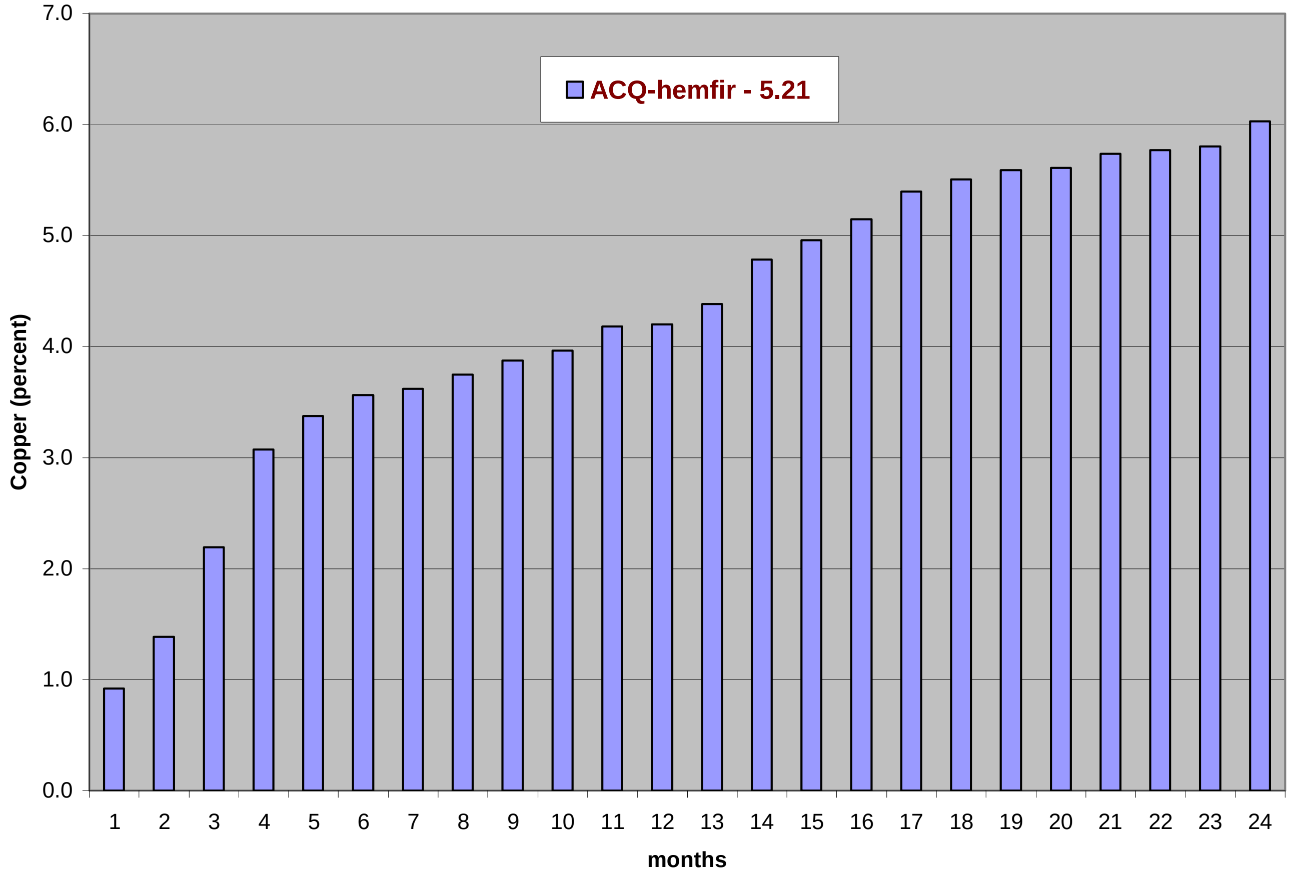

Figure 2. Cumulative loss of copper from ACQ treated decking boards after 2 years of exposure

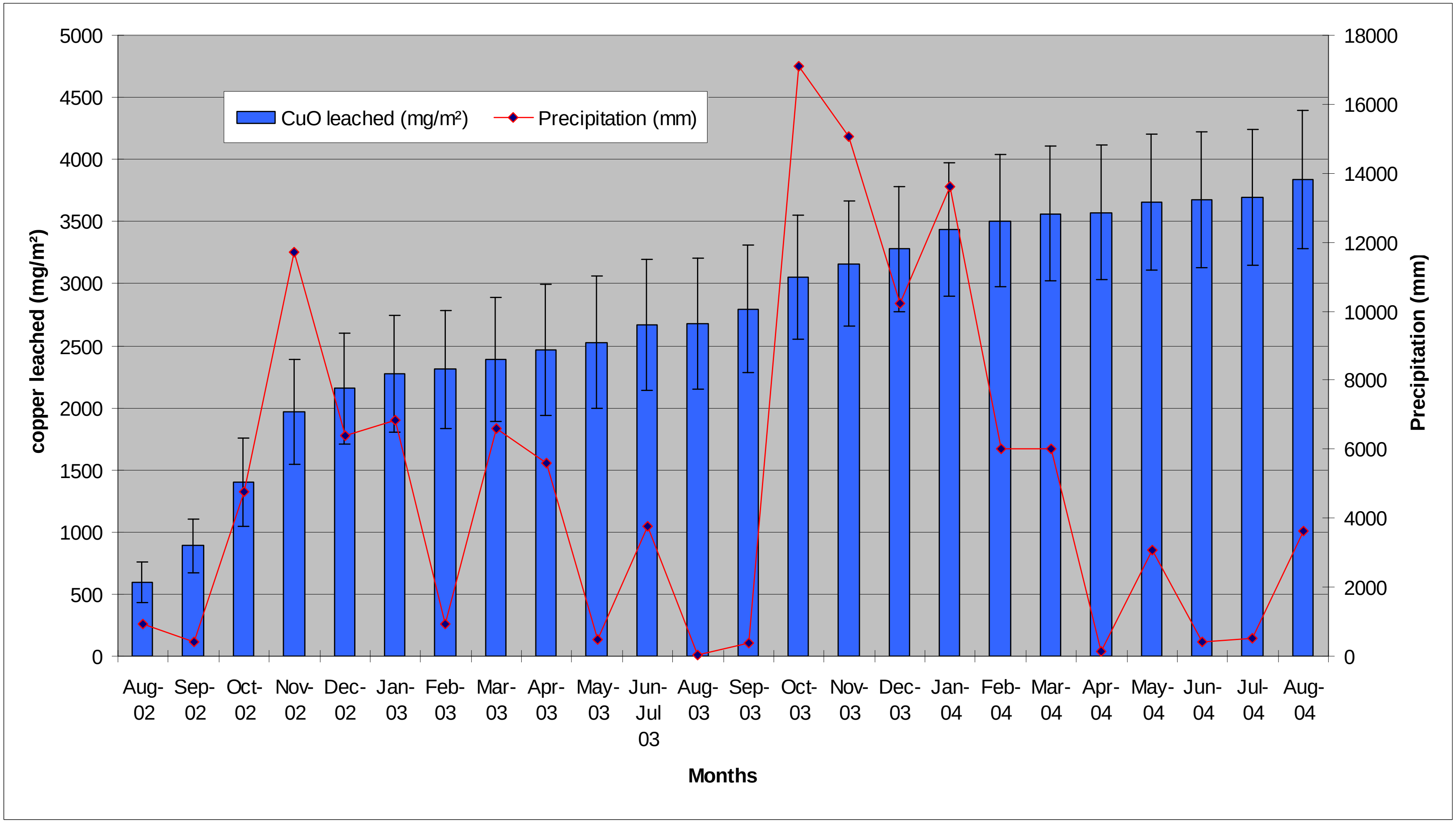

Figure 3. Cumulative loss of copper (mg/m^2) of copper leached

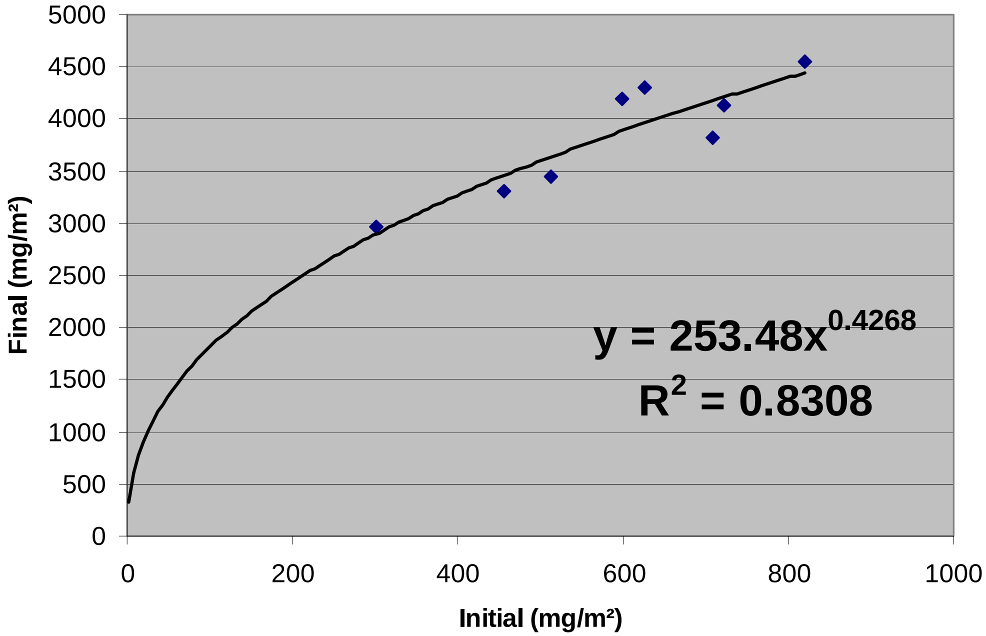

Figure 4. Final and initial copper losses after two years of exposure of ACQ decking samples

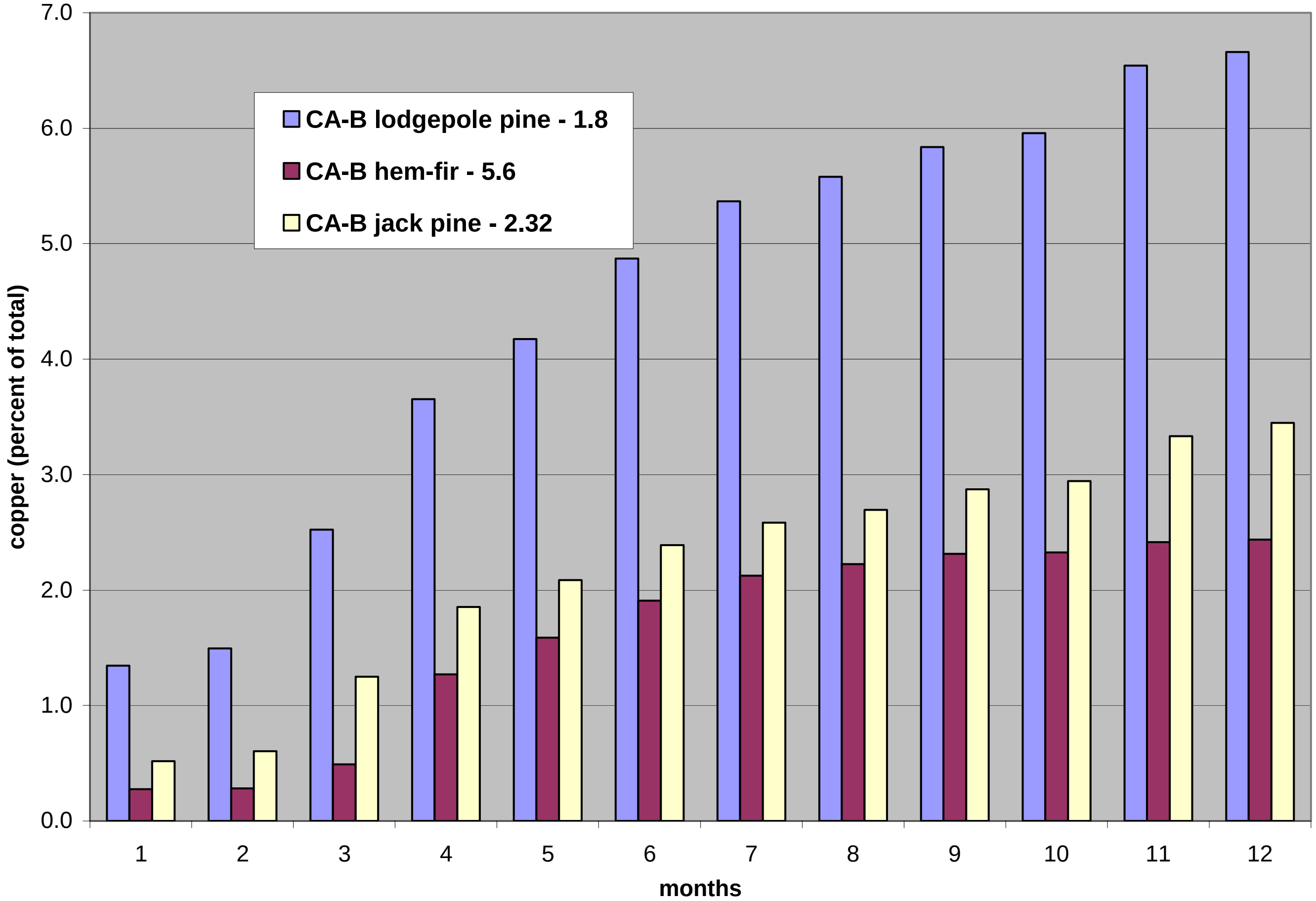

Figure 5. Copper depletions in lodgepole pine, jack pie and hem-fir decking samples after 1 year.

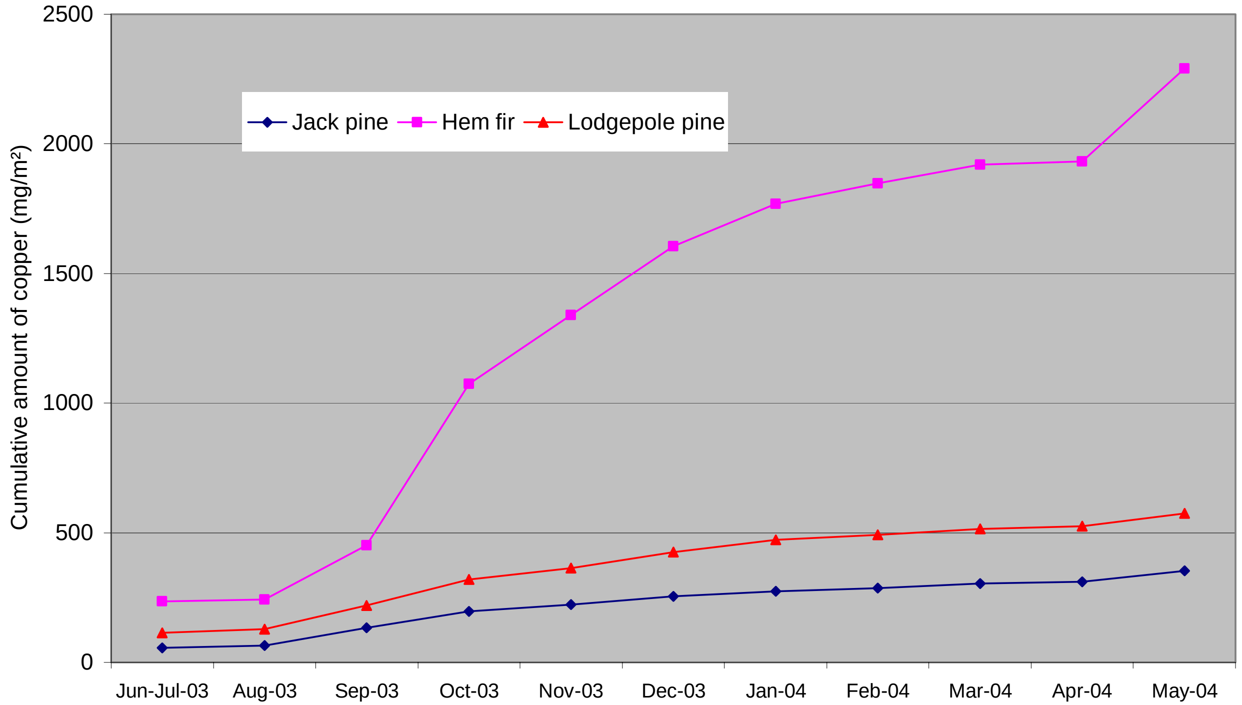

Figure 6. Cumulative loss of copper for copper azole treated lodgepole pine, jack pine and hem-fir decking samples

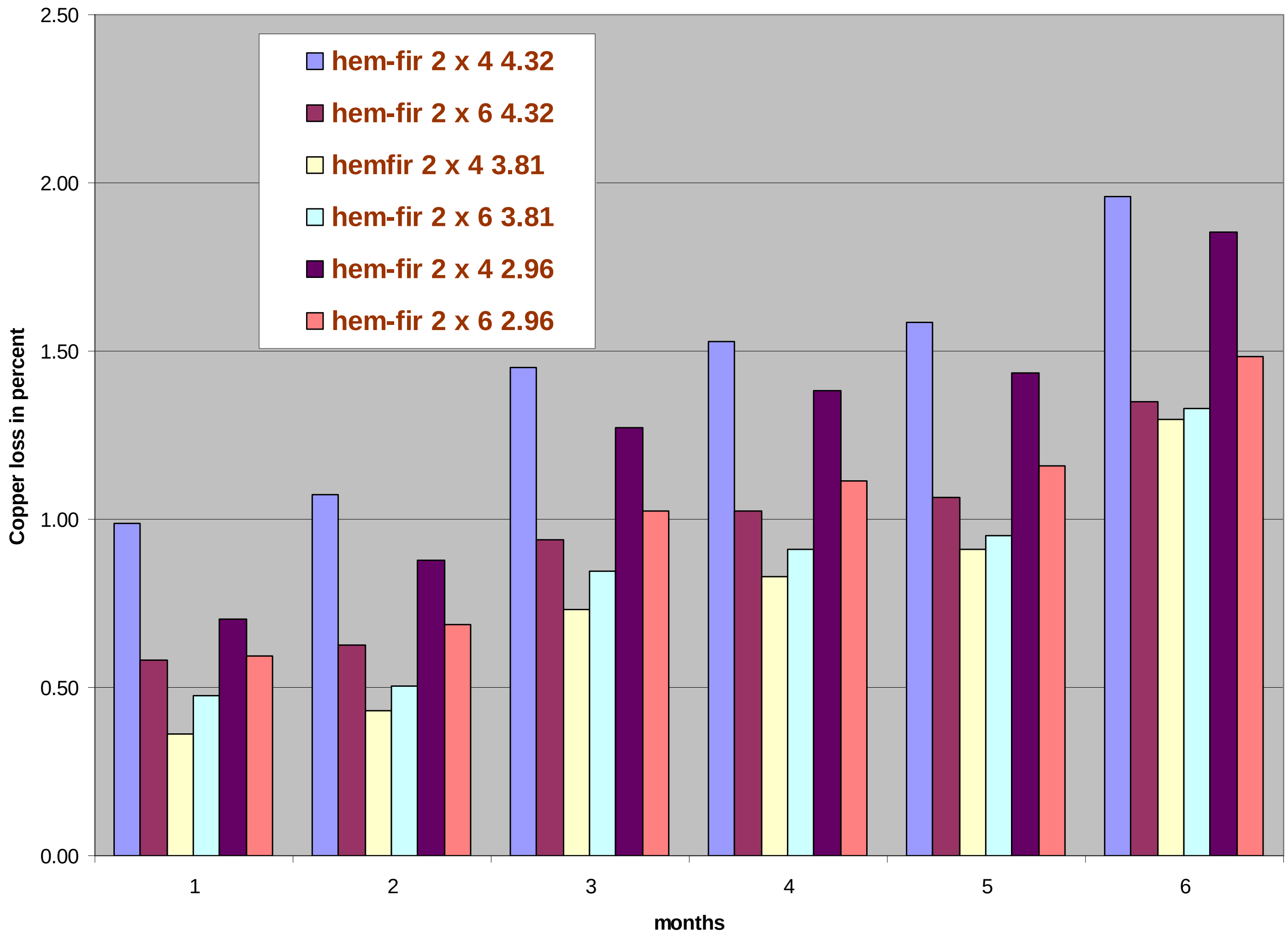

Figure 7. Cumulative loss of copper for 2 x 4 and 2 x 6 hem-fir decking boards treated with CX

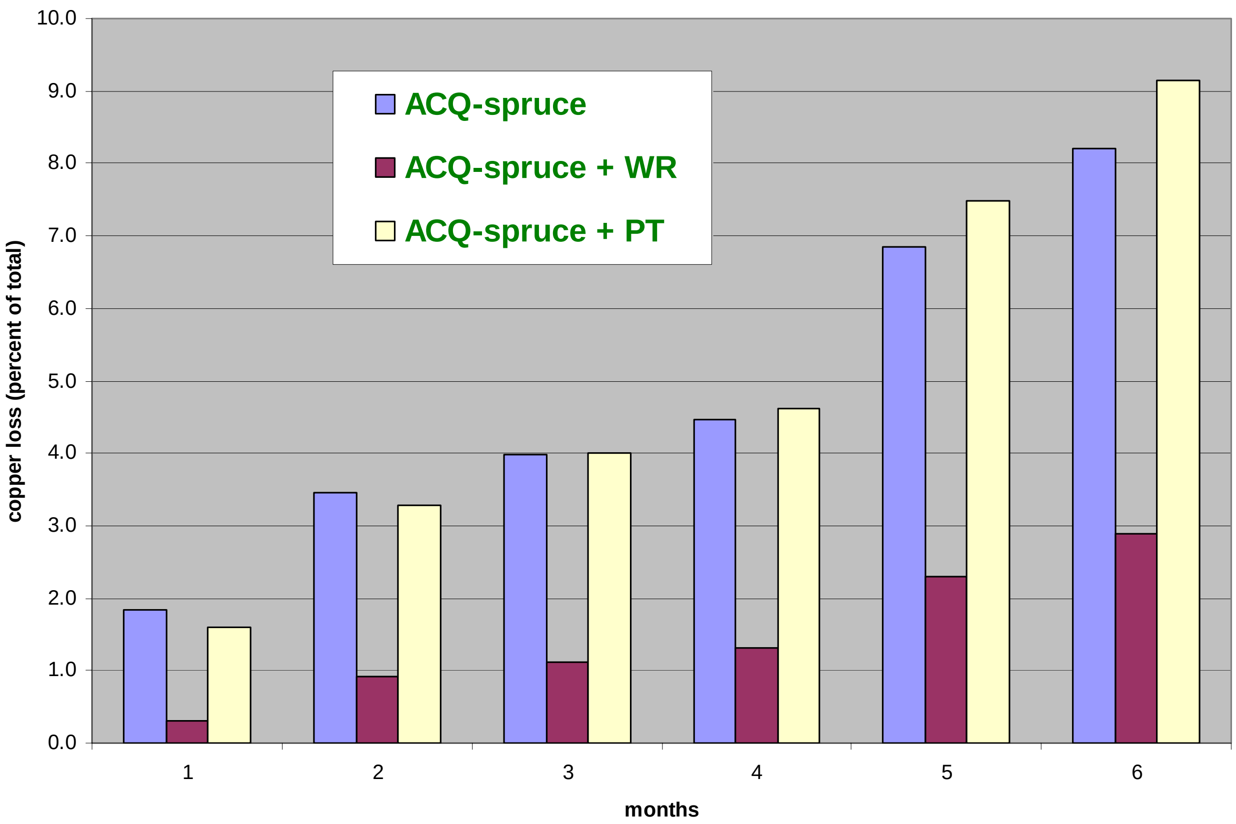

Figure 8. Loss of copper from ACQ treated decking boars which were a) pressure washed with water, or b) brushed with a water repellant product.