# Poulticing Poison: the Mitigation of Arsenic with Latex Rubber

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## Abstract

Arsenic compounds were commonly employed as pest control measures in ethnographic collections until the middle of the 20th century. Because of their ubiquity, persistence and acute human toxicity, methods of arsenic detection and mediation are needed to protect those who regularly come into contact with affected items. This is especially important in the context of repatriation, as contaminated objects are sometimes returned to regular use by Native communities and current mitigation methods are not always culturally acceptable. This study evaluates the efficacy of latex rubber poultices by comparing the intensity of arsenic in doped wood before and after poultice application as measured by x-ray fluorescence spectroscopy. Results are verified with laser ablation inductively coupled plasma mass spectrometry. When used alone, latex rubber is found to greatly reduce arsenic levels in the doped wood. The addition of a ferric oxide chelator causes a slightly larger reduction.

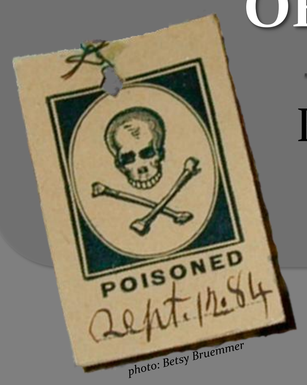


photo: Betsy Bruemmer

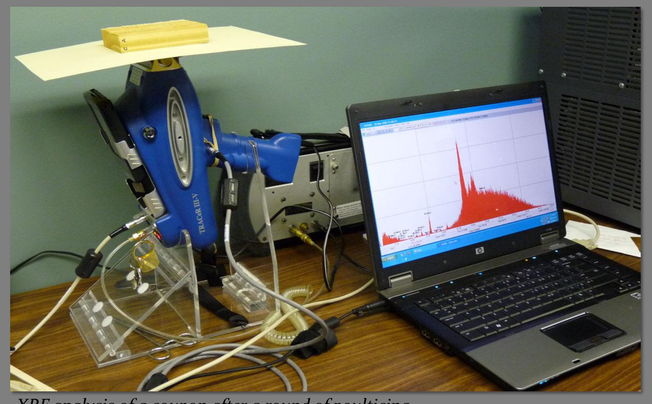
## Introduction

Ever since the passage of the Native American Graves Protection and Repatriation Act in 1990, the ability to detect heavy metal pesticides and protect Native communities from the dangers associated with these toxic compounds has become increasingly important. Several promising methods for the detection and removal of pesticides from objects have been developed, but an affordable, culturally sensitive, safe, non-destructive method has not yet been found. This project evaluates the efficacy of one such practical method: the use of an inexpensive, non-toxic, natural product – latex rubber – to reduce a once-commonly employed heavy metal pesticide, "white arsenic", or arsenic trioxide.


*Applying poultices (left: latex rubber + iron oxide, right: latex rubber)*

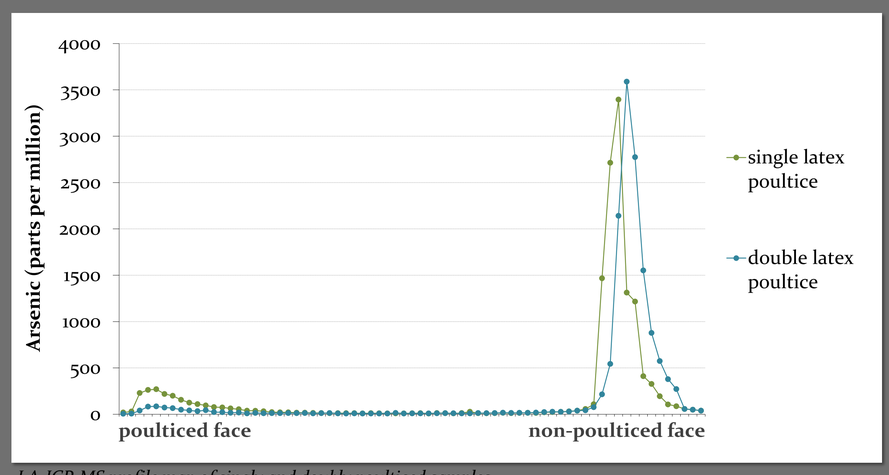
## Procedure

A concentrated aqueous solution of arsenic trioxide ($As_2O_3$) was used to dope samples of two wood species: red cedar and basswood. The arsenic-laden wood was then poulticed with one of two different poultice formulations, latex or latex with the chelating agent iron (II) oxide. Poultices were applied to each sample twice to see if results could be improved by repeated application. The samples were analyzed with a Bruker Tracer III-V handheld energy-dispersive XRF spectrometer before and after each poultice so that any reduction in arsenic could be detected. A template was employed to ensure readings were taken in the same spot each time. Cross sections of two samples, one that had been poulticed once and another that had been poulticed twice were submitted for further analysis by LA-ICP-MS.

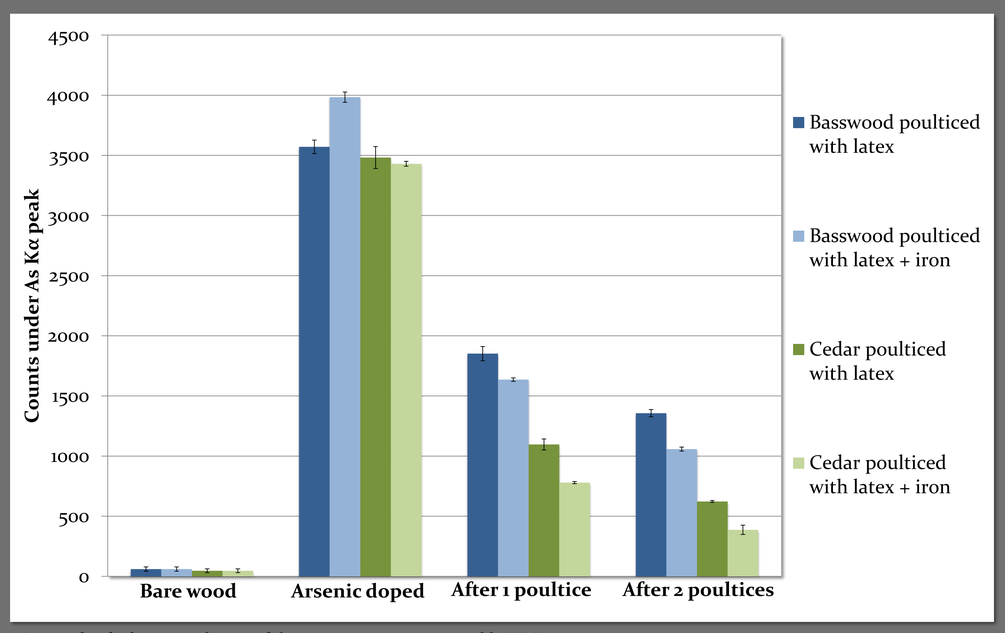

*XRF analysis of a coupon after a round of poulticing*

## Results

Both latex rubber poultice formulations were successful in reducing the amount of arsenic detected in red cedar and basswood. The poultice with a chelator was more effective than that using latex rubber alone. The first round of poulticing achieved the greatest reduction in arsenic, with the second application removing more. While XRF was useful in measuring this outcome on the surface, LA-ICP-MS line scans show that the poultices were also able to extract arsenic from deep within the wood. Final concentrations measured by LA-ICP-MS reveal a total reduction of 97.7%, a figure somewhat higher than the 89% calculated from XRF measurements. One potential problem was discovered during the experiment: stains were noted on the wood after removal of cured poultice masses. This could be from incomplete removal of the latex rubber or an unintended consequence of the latex's carrier, ammoniated water. While these results are promising, it must be stated that this particular technique will only be successful if the offending heavy metal compound is water soluble. Because of the staining and potential for physical damage, the method is only useful on smooth, undecorated surfaces. Without the ability to quantify results, it is difficult to determine whether levels safe for human contact have been reached using this method.



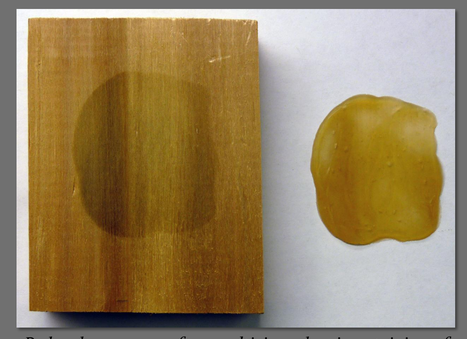
*LA-ICP-MS profile map of singly and doubly poulticed samples*



*Arsenic levels during each step of the experiment as measured by XRF*

| Poultice | Wood | % change after 1st poultice | % change from 1st to 2nd poultice | Total % change from doped wood |
|---|---|---|---|---|
| Latex | Basswood | -48 | -26 | -62 |
| | Red Cedar | -68 | -43 | -82 |
| Latex + iron oxide | Basswood | -59 | -35 | -73 |
| | Red Cedar | -77 | -50 | -89 |

*Percent reductions in arsenic achieved by latex rubber poultices based on XRF measurements*


*Red cedar coupon after poulticing, showing staining of the wood by the poultice*

## Conclusion

This study has demonstrated the efficacy of latex rubber poultices, both with and without chelating agents, for the removal of arsenic applied to wood. Refinement of this technique through careful control of poultice formulations could make it more broadly applicable, more efficient and less destructive, offering a safe, inexpensive solution to an urgent problem.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