

# Silver Tarnishing Properties of Gloves Used in Conservation

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## Introduction

Over the last decade, concern has grown over the possible presence of sulfur and chloride compounds within gloves used in conservation. If these compounds are present in our hand protection, what effect could this have on silver objects? Could the everyday preventative measure to protect silver from tarnishing actually be causing harm? Unfortunately, when reviewing the current conservation literature, little information on the subject was found. This research project analyzed cotton, latex, nitrile, and vinyl gloves to determine if any induced tarnishing to silver and sterling silver through a modified Oddy test, which placed samples of the various glove types into direct contact with coupons of both metals. Sodium azide, silver nitrate, and Beilstein tests were conducted to identify if produced tarnish was caused by either chlorides, sulfides, or both. Results have shown that all glove types except a variety of nylon glove with polyurethane fingers induced tarnishing ranging from slight to severe having been most likely caused from sulfur.

## Experimental

### Sample Selection:

To analyze a variety of gloves used by conservators, the sample size was set at eight different types:

- Kimberly-Clark™ Purple Nitrile™, Powder-Free
- Microflex®, Ultra Sense™, Nitrile, Powder-Free (Blue)
- Ansell, Touch N Tuff®, Nitrile, Powder-Free (Green)
- Microflex®, Derma Free® Vinyl, Powder-Free
- Ansell, Conform® XT, Latex, Powder-Free
- White cotton
- "Sure Grip", cotton gloves covered with P.V.C dots
- Klass Ltd., Nylon gloves with polyurethane-coated fingers



Glove Samples

### Result: Silver Nitrate Test

Glove Types	Precipitate Formed	No Precipitate Formed
Cotton	Yes, moderate	-
Polyurethane fingers	-	Yes
Conform® XT	Yes, slight	-
Derma Free®	Yes, slight	-
Sure Grip	Yes, slight	-
Ultra Sense™	Yes, slight	-
Touch-N-Tuff®	Yes, slight	-
Kimberly-Clark™	Yes, slight	-

If a cloudy white precipitate formed, it is a positive result for the presence of chlorides.

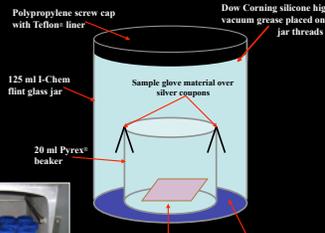
### Method: Oddy Test (accelerated corrosion test)

A modified Oddy test was conducted using the various glove materials with silver and sterling silver coupons. Triplicate sets for each glove type were made along with three controls and placed in random order into an oven for 28 days at 60°C.

- The samples of glove material were mounted over the coupons and held in place by slits in their corners to create direct contact between them.
- Additional glove materials were placed in the bottoms of the beakers to see if they reacted differently than the samples in contact with the coupons.



Test jars and oven



Oddy Test Setup



Glove sample

Folded silver coupon

### Method: Silver Nitrate Test (presence of Chlorides)

One of each glove type was placed into a 200 ml beaker with the addition of 150 ml of distilled water and allowed to soak for a period of one day. The soak water was then transferred to test tubes and placed along side a control tube containing only distilled water. Two drops of silver nitrate were added to each tube which were then compared to the control.



Glove samples soaking

### Method: Beilstein Test (presence of Chlorides)

Glove samples were held next to the air intake of a propane torch while a piece of 22 gauge copper wire was heated red-hot and then immediately touched to the samples. As the glove materials were pyrolyzed by the wire, any fumes produced were drawn into the flame.



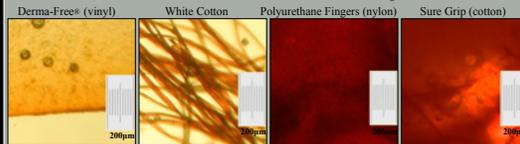
Propane torch used

### Method: Sodium Azide Test (presence of sulfides)

Two 0.5 cm<sup>2</sup> samples of each glove variety were mounted onto a glass slide with cover slips. Each slide was viewed under 40X magnification using transmitted light. A drop sodium azide solution was introduced along the side of one cover slip and was soon pulled under it by capillary action. The sample was then observed for a period of one minute, during which the amount of nitrogen bubbles produced (if any) was assessed.

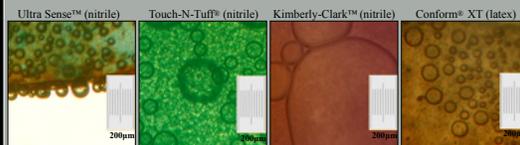
### Result: Sodium Azide Test

#### Gloves varieties that do not contain sulphur



The absence of a significant production of nitrogen bubbles from these samples indicates that sulphur is not present within these gloves materials and that tarnish induced from them is chloride related.

#### Gloves varieties that contain sulphur



The vigorous and immediate evolution of nitrogen bubbles from these glove materials indicates that sulphur is present within the materials, which is likely to be partially or fully responsible for the tarnishing induced by these gloves.

### Result: Oddy Test

Glove Types	Tarnish Present	Degree of tarnishing
White cotton	Yes	Slight
Polyurethane fingers	NO, some glove residue present	-
Conform® XT	Yes, some glove residue present	Severe
Derma Free®	Yes	Slight
Sure Grip	Yes, some glove residue present	Slight
Ultra Sense™	Yes	Moderate to Severe
Touch-N-Tuff®	Yes	Severe
Kimberly-Clark™	Yes	Severe

The test identified which glove types induce tarnishing to silver and sterling silver. Also, note that several glove varieties left deposits of glove material adhered to the test coupons.



Sterling silver coupon with controls after Oddy testing with a sample of Conform® XT (latex)



Sterling silver coupon with controls after Oddy testing with a sample of rubber-fingered glove, note slight residue transfer

## Conclusions

The results from this project have shown that all varieties of glove tested except for the nylon gloves with polyurethane-coated fingers tarnished silver and sterling silver. At the present time, it seems that the worst tarnishing was induced from sulfur within nitrile and latex gloves. However, the sample coupons need to be analyzed for the presence of sulfur within their corrosion products to confirm the visual observations. Further testing is also required to determine if residue transfer seen after the Oddy test occurs under normal conditions.

