

# Adhesive Smackdown: Consolidating a Synthetic Leather Wrestling Costume

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## 1. Introduction

Synthetic leather is a multi-faceted material providing many challenges to the textile conservator. This poster describes the researching and testing of various consolidants for use with the ultrasonic nebulizer on flaking synthetic leather, the purpose of which was to find a suitable treatment for a garment sent by World Wrestling Entertainment (WWE) to the Textile Conservation Workshop. The garment once served as ring entrance gear for Hall of Famer, Shawn Michaels, but arrived at the Workshop severely degraded with very little of the "skin layer" still adhered to the nylon knit substrate.



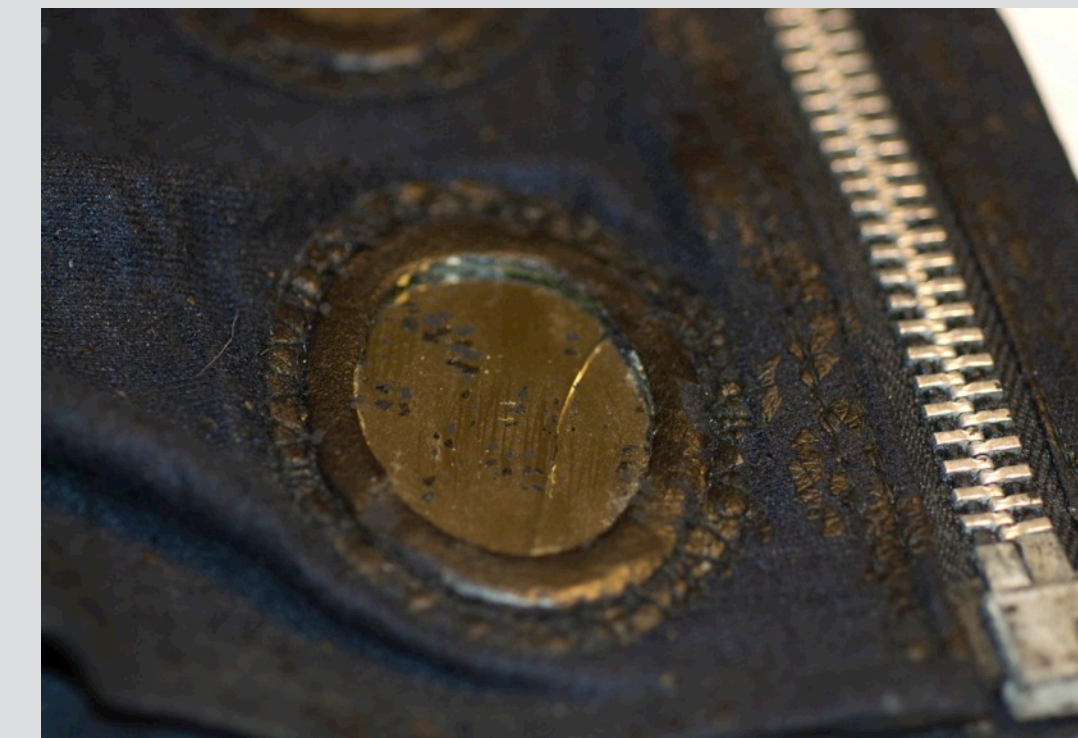
Top, as it arrived at the Workshop



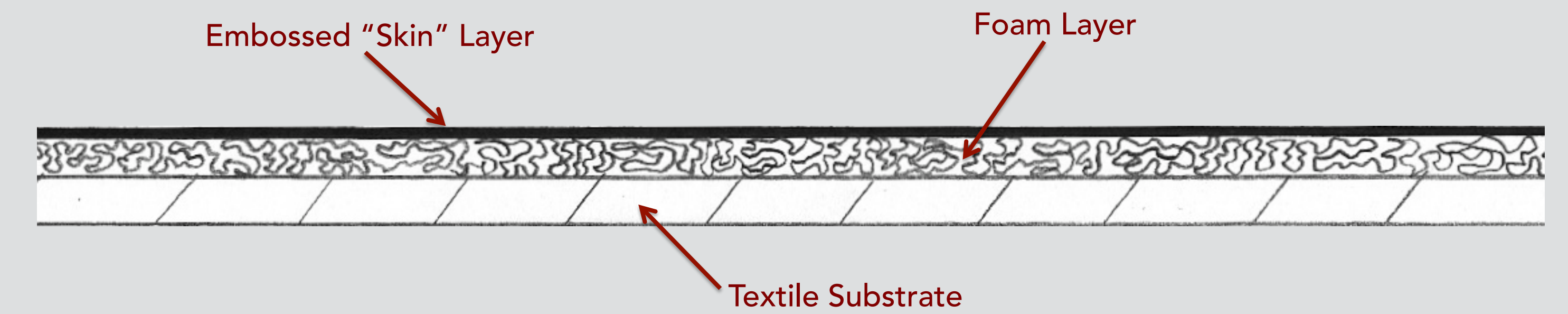
Chaps, as they arrived at the Workshop



Detail of remaining skin layer



Detail of damaged mirror and textile substrate



Beilstein copper test



Boiling in NaOH

## 2. Determining the Type of Synthetic Leather

The first step in deciding a course of treatment was to determine the materials of construction of the "leather". Research revealed that synthetic leather since the 1960s is either polyurethane or poly (vinyl chloride) (Kerr and Batcheller 1993). Using this as a starting point, a Beilstein copper wire test was conducted for the presence of halides, which PVC has but polyurethane does not. Halides would combine with the copper (II) oxide formed from heating the wire and produce a green gas. As no green gas was emitted when the wire was touched to the samples, they were judged to be polyurethane (CCI Notes 1993). The two types of polyurethane, polyester and polyether, can further be differentiated by boiling a sample in a 10% solution of NaOH for 30 minutes. Polyester-based polyurethane will dissolve in the solution, whereas polyether-based will not (Textile Institute 1975). Our sample did dissolve and was therefore concluded to be polyester-based polyurethane.

## 3. How Polyurethane Degrades

As polyurethane degrades, its layers can delaminate and crack. Plasticizers migrate to the surface of the "skin layer", making it tacky (Paulocik and Williams 2002). While these results are common to both types of polyurethane, the cause is dependent on the polyurethane base. Polyether polyurethane degrades mainly by oxidation, whereas polyester polyurethane degrades mainly by hydrolysis (Lovett and Garside 2005). An example in the literature is a Libro chair, designed by Gruppo DAM and constructed from polyester polyurethane. It bears a whitish handprint, found to be adipic acid anhydride, which is the result of a breakdown of the polyester components from sweat (Bechtold 2005). Sunlight was proven to hasten the degradation of both types of polyurethane (Kerr and Batcheller 1993). Therefore, one is treating a material commonly used in furniture and clothing, but which degrades when exposed to the natural conditions of both. Even the foam structure of polyurethane only contributes to the rate of degradation by increasing the surface area. (Lovett and Garside) In fact, dresses from the 1960s displayed signs of degradation as early as 1977 (Lovett and Eastop 2004).

## 4. How Has Polyurethane Been Treated Before?

Most of the previous literature concentrates on polyurethane used in sculpture, which is similar to that used in textiles, albeit without a textile substrate and with a greater volume of foam. Variations on these treatments, including those conducted by the Netherlands Institute for Cultural Heritage, J. Butzer, and T. Bechtold, can be applied to the textile field because of the foam layer found in polyurethane synthetic leathers (Oosten 2011).

When considering which adhesives could be used to consolidate the wrestling garment, the following parameters were used: the adhesive had to be strong enough to withstand minimal handling while retaining the original flexibility and sheen of the textile. It had to be able to nebulize well, as the ultrasonic nebulizer was deemed the best delivery method to adhere the flakes without moving them around and lastly, it was preferable that it be soluble in either water or minimally toxic solvents. Considering these factors, and the literature cited above, the following four adhesives were selected for trial: Gelatin, Paraloid B72, Plextol B500 and Impranil DLV.

## 5. Testing the Selected Adhesives

Tests were performed using the polyurethane flakes found at the bottom of the delivery box and black and white nylon knits. The flakes were adhered first to the white samples, where they'd be more visible, and then to the black, to test for visual compatibility. They were tested for adhesion using a soft brush and a blower bulb. The starting concentrations were chosen from recommendations for use with the nebulizer, previous treatments, and literature.

**Gelatin:** I started with a .75% solution in deionized water. Although it nebulized beautifully, the flakes did not adhere well and the nylon substrate became very stiff. A 1.5% solution was applied with a brush but still did not suitably adhere the flakes and was therefore not tested with the nebulizer.

**Plextol B500:** I began with a 5% solution in deionized water. It wouldn't nebulize and when applied with a brush, the flakes did not adhere. A 4% solution did nebulize, but the flakes lifted off. Using this same solution, I tried focusing on a 5cm square area for two minutes, as done by Van Oosten with Impranil DLV in *PUR Facts*. Although I could lift the flakes with my finger, they did not brush or blow off. The substrate, however, became stiff.

**Paraloid B72:** I began with a 1% solution in ethanol:acetone (2:1). The flakes adhered well and did not brush or blow off. A slight sheen could be seen in certain areas under the stereomicroscope. The substrate became slightly stiff, but less so than with the Plextol B500.

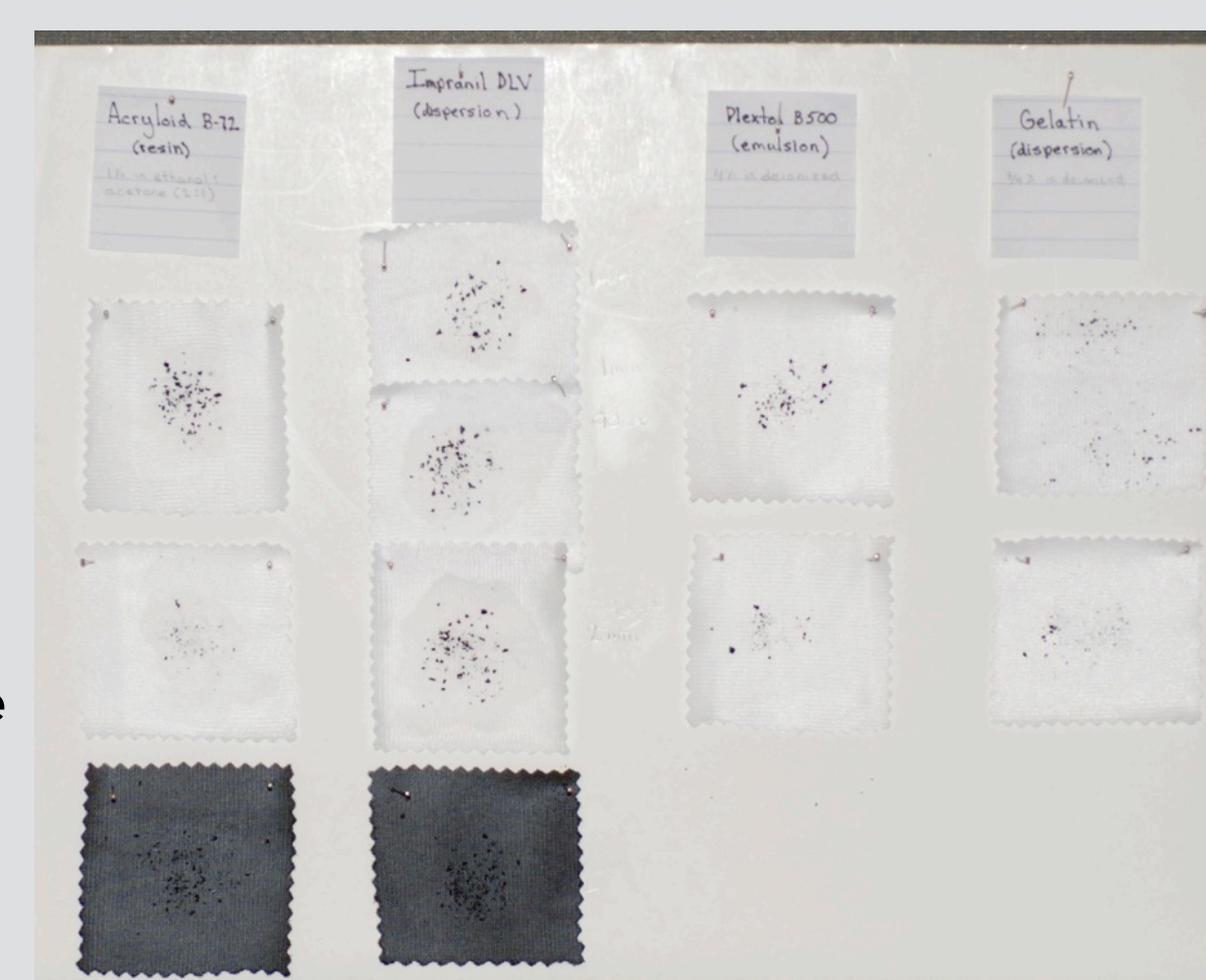
**Impranil DLV:** I started with a 20% solution in water:isopropanol (4:1). It both nebulized and adhered well. Hoping for even better results, I tried a 22% and a 24% solution. The 22% solution proved marginally more effective, but the 24% solution did not nebulize well. I then tested 20%, 22% and 24% of solutions of the adhesive mixed only in water. All percentages nebulized excellently and it was found that the water-only solution left the substrate slightly more flexible



Adhered flakes before testing



Tools used to test adhesion of flakes



Adhered flakes after testing

## 6. Treatment of the Wrestling Costume

Impranil DLV adhered the flakes the best and altered the hand of the nylon the least, making it the best choice for use on the wrestling costume. Powder from the degraded foam layer of the synthetic leather covered the costume and was vacuumed away where no "skin" flakes remained. The powder proved troublesome where flakes remained because it caught the nebulized adhesive and left a frosty appearance. This was largely avoided through perfection of the application technique, taking pains to apply the adhesive at a 90 degree angle and avoiding excess clouds of mist. After consolidation, the PUR synthetic leather skin layer was successfully re-adhered to the nylon substrate with minimal to no change in sheen or flexibility. The mirrors and chains on the garment were cleaned of polyurethane residue by swabbing with isopropanol and gently scraping with a microspatula. The treated garment was lightly padded with tissue and placed in an archival box with two trays. The top received a partial insert made of Tyvek-covered board, to which the chains were secured with interwoven twill tape.



Before treatment



Frosty appearance after treatment



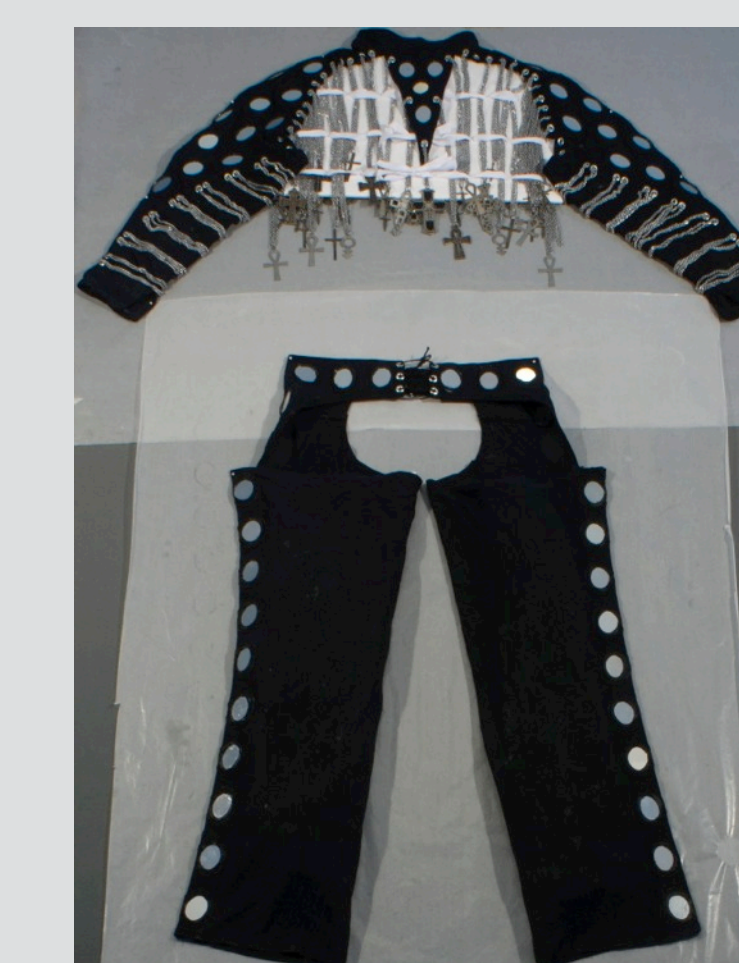
Before treatment



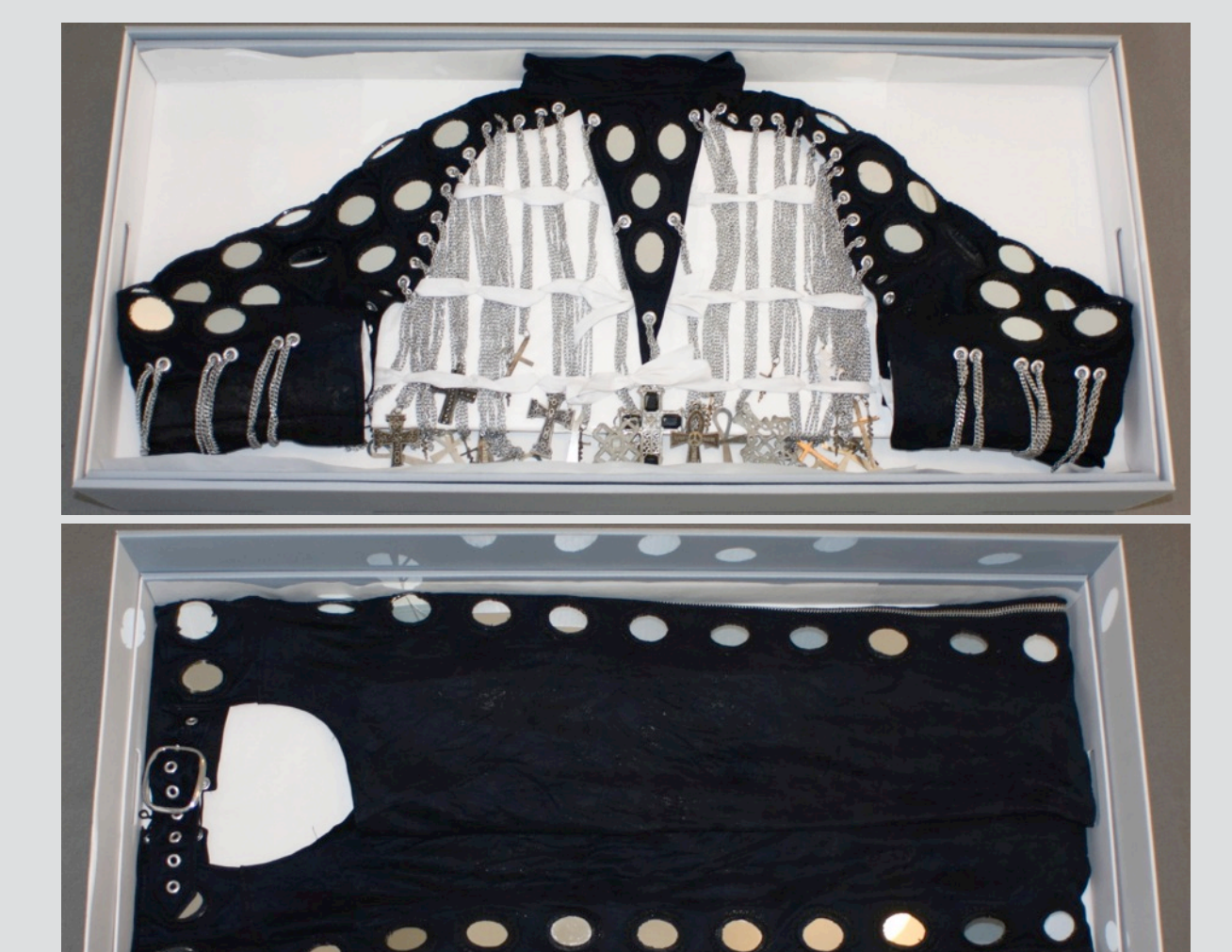
After treatment



After treatment, front



After treatment, back



Treated garment, packed in its custom box

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## Materials

Impranil DLV  
Bayer Material Science LLC  
100 Bayer Road, Pittsburgh, PA  
15205-9741  
1-800-662-2927  
www.bayermaterialsciencenafta.com

Plextol B500, Paraloid B72, and Gelatin  
Talas  
330 Morgan Avenue,  
Brooklyn, NY 11211  
212-219-0770  
www.talasonline.com

Ultra-Neb Large Volume  
Ultrasonic Nebulizer 099 HC  
DeVilbiss Healthcare  
100 DeVilbiss Drive  
Somerset, PA 15501  
1-800-338-1988  
www.devilbisshealthcare.com

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