Safer and Effective Alternatives to Methylene Chloride For Paint Stripping Products

September 12, 2017
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University of Massachusetts Lowell
Lab Testing: Coupon Preparation

**Substrates:**
wood, metal, masonry

**Coatings:**
- 1 primer coat
- 4 finish coats (except 6 coats for a mixed coating coupon on wood)
- Lightly sand with 100 grit sandpaper and wipe clean with isopropyl alcohol before each coating (to promote better adhesion between coating layers)

**Aging:**
3 weeks in oven at 140 F (to simulate 11 months of aging)
Lab Testing Procedure

• Glue a 1.5 inch rubber ring gasket on the test area of the test vehicle
• Use a clean pipette to add 1.5 ml of solvent blend inside the ring gasket
• Cover the ring gasket with a lab watch glass
• Start timer to initiate dwell time
• Record initial cracking time
• After dwell time: remove watch glass
• Lightly scrape off coating residue with plastic scraper & record substrate exposure
Lab Test Results – Example

0% (bold and underline) substrate exposure (top layer not affected)

0% substrate exposure (some layer(s) removed)

60% substrate exposure

95% substrate exposure
Lab Test: Methylene Chloride Based Paint Strippers

**Strypeeze:**
- Methylene chloride (25% – 30%), methanol (25 – 30%), toluene (15 – 20%), and acetone (15 – 20%).

**Klean Strip Stripper:**
- Methylene chloride (60% – 100%), methanol (15 – 25%).

**Super Remover MultiLayer Stripper:**
- Methylene chloride (60% – 100%), methanol (5 – 10%), and toluene (1 – 5%).

**SuperStrip:**
- Methylene chloride (85% - 90%), methanol (5 – 10 %), and toluene (0 – 5%).
Lab Test: Alternative Products

- NMP, Benzyl Alcohol, & Formic Acid
- DMG, DMA, DMS, Triethyl phosphate
- Acetone/glycol ether
- NMP, DMG, DMA, DMS
- NMP, Benzyl Alcohol
- Benzyl alcohol
- Benzyl alcohol, water

Meeting materials submitted by Gregory Morose for EPA’s Public Workshop on Use of Methylene Chloride in Furniture Refinishing on September 12, 2017
**Lab Test: University of Massachusetts Lowell (UML) Formulations**

<table>
<thead>
<tr>
<th>Formulation*</th>
<th>Solvents</th>
<th>Approximate Solvent Cost ($ per lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formulation Y</td>
<td>Methyl acetate, DMSO, Thiophene</td>
<td>$0.75</td>
</tr>
<tr>
<td>Formulation 4</td>
<td>Methyl acetate, DMSO, Thiophene</td>
<td>$0.94</td>
</tr>
</tbody>
</table>

Wood Substrate - Coatings

- Oil based primer
- Latex paint
- Epoxy
- Lacquer
- Varnish
- Oil based paint
- Shellac
- Polyurethane
**Wood Test Coupons**

Pine wood substrate  
3.5” wide x 15” long

<table>
<thead>
<tr>
<th>Standard coupon</th>
<th>Mixed coupon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood substrate</td>
<td>Wood substrate</td>
</tr>
<tr>
<td>Oil primer (white)</td>
<td>Oil primer (white)</td>
</tr>
<tr>
<td>Topcoat X</td>
<td>Topcoat X</td>
</tr>
<tr>
<td>Topcoat X</td>
<td>Topcoat X</td>
</tr>
<tr>
<td>Polyurethane</td>
<td>Polyurethane</td>
</tr>
<tr>
<td>Polyurethane</td>
<td>Polyurethane</td>
</tr>
<tr>
<td>Oil topcoat (grey)</td>
<td>Oil topcoat (grey)</td>
</tr>
<tr>
<td>Latex topcoat (red)</td>
<td>Latex topcoat (red)</td>
</tr>
<tr>
<td>Oil topcoat (red)</td>
<td>Oil topcoat (red)</td>
</tr>
</tbody>
</table>

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Lab Test Results Summary:  
% Wood Substrate Exposed After Test

<table>
<thead>
<tr>
<th>Coupon</th>
<th>Dwell Time (min)</th>
<th>Stryp-seeze</th>
<th>Super Strip</th>
<th>Klean Strip</th>
<th>Super Remover</th>
<th>UML Form Y</th>
<th>UML Form 4</th>
<th>Eco-Fast</th>
<th>Peel Away</th>
<th>Citri-Strip</th>
<th>Ready Strip</th>
<th>EZ Strip</th>
<th>Lift-Off</th>
<th>Smart Strip</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epoxy  (4)</td>
<td>20, 10</td>
<td>80</td>
<td>95</td>
<td>99</td>
<td>100</td>
<td>90</td>
<td>80</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Shellac (4)</td>
<td>8</td>
<td>65</td>
<td>75</td>
<td>70</td>
<td>90</td>
<td>85</td>
<td>70</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Lacquer (4)</td>
<td>10</td>
<td>75</td>
<td>95</td>
<td>85</td>
<td>85</td>
<td>90</td>
<td>95</td>
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<td>0</td>
<td>0</td>
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<tr>
<td>Polyur. (4)</td>
<td>10</td>
<td>95</td>
<td>85</td>
<td>85</td>
<td>80</td>
<td>90</td>
<td>95</td>
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<td>Varnish (4)</td>
<td>20, 12</td>
<td>85</td>
<td>85</td>
<td>85</td>
<td>95</td>
<td>100</td>
<td>80</td>
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<td>Oil (4)</td>
<td>25, 10</td>
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<td>95</td>
<td>95</td>
<td>70</td>
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<td>0</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Latex (4)</td>
<td>25</td>
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<td>80</td>
<td>85</td>
<td>70</td>
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<td>70</td>
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<tr>
<td>Mixed</td>
<td>20, 15</td>
<td>85</td>
<td>90</td>
<td>85</td>
<td>95</td>
<td>95</td>
<td>60</td>
<td>0</td>
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<td>0</td>
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<tr>
<td><strong>Average</strong></td>
<td><strong>83</strong></td>
<td><strong>87</strong></td>
<td><strong>86</strong></td>
<td><strong>89</strong></td>
<td><strong>89</strong></td>
<td><strong>78</strong></td>
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<td><strong>0</strong></td>
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All coupons have one layer of oil based primer.
Field Testing at Belcastro Furniture Restoration in Tyngsboro, MA

Decorative column
Approximately 115 years old
Several layers of lead based paint

Paint Stripper Materials

<table>
<thead>
<tr>
<th>Product</th>
<th>Supplier</th>
<th>Ingredients</th>
</tr>
</thead>
</table>
| B7 Industrial Paint Remover  | Benco Sales Inc., Crossville, TN | Methylene chloride 70% - 80%
|                              |                             | Methanol 5% - 15%
|                              |                             | 2-Butoxyethanol 1% - 10%
|                              |                             | 2-Methoxymethylthoxpropanol 1% - 3%
|                              |                             | Wetting agent and wax 1% - 5%                                              |
| Formulation #4               | University of Massachusetts Lowell | Methyl acetate
|                              |                             | Dimethyl sulfoxide (DMSO)
|                              |                             | Thiophene                                                                  |

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Field Testing Procedure

The paint removal method conducted by the Belcastro operator consisted of the following iterative process:

1. Application of the paint stripping materials onto the surface of the decorative column
2. Allowing the paint stripper to remain on the surface of the column for a few minutes
3. Scrubbing the area with ScotchBrite™ scouring pads and wire brushes
4. Wipe the area clean with a cloth rag so that photos could be taken

Steps 1 – 4 were repeated several times so that photos could be taken after 20 minutes, 29 minutes, 34 minutes, and 39 minutes of testing.
Field Testing Results

Initial application:
Time = 0 minutes

B7 Methylene Chloride

Time = 20 minutes

UML Formulation #4
Field Testing Results

Time = 29 minutes

B7 Methylene Chloride

Time = 39 minutes

UML Formulation #4
Summary of Testing Results

Lab Performance Testing:

Performance testing at the TURI Laboratory was conducted for a variety of coating materials on wood, masonry, and metal substrates. The testing results showed that the new solvent blends developed by UMass Lowell, worked equally to methylene chloride-based paint strippers and significantly better than other existing alternatives based on chemicals such as NMP, benzyl alcohol, and dibasic esters.

Field Performance Testing:

UMass Lowell Formulation #4 performed equally to the methylene chloride based product for removing multiple layers of lead paint from an old wood substrate.