

PIGMENTED WAX/RESIN FILLS

FOR THE CONSERVATION OF PAINTINGS

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PIGMENTED WAX/RESIN FILLS are made and used by painting conservators to fill losses in oil paintings. It is an ideal material because textures, such as canvas weave, can be impressed into the fills to match the painted surface. In addition, coloring the wax with pigments can aid in the inpainting process. The Buffalo State College Art Conservation Program employs a successful pigmented wax/resin fill formula that uses beeswax, microcrystalline wax, resin, and pigments (Table 1). One of the components, Laropal® K-80, a resin that gives more hardness and tack to the fill, is no longer manufactured. The purpose of this investigation was to research and find an alternative resin that would yield an equal or improved pigmented wax/resin fill. Another aspect was to identify the advantages and limitations of pigmented wax fills in general. By developing a practical wax fill formulation and application process, a better understanding and appreciation of pigmented wax/resin mixtures may be gained.

EFFECTS OF AGE

Frederick Wallace, who is now Chief Conservator of the Mariners' Museum in Newport News, Virginia, researched wax fills as a student 21 years ago. 20 wax samples, included in his research project, were examined. They consisted of different wax mixtures, many of which contained pigments but none contained resin. By observation only, it was concluded that the two main consequences of aged pigmented wax included cracking and bloom. Almost all of the ten samples that contained beeswax had a white efflorescent bloom. This could be the result of low molecular weight volatiles migrating to the surface over time.

QUESTIONNAIRE

Many conservators use wax fills but their mixtures and application methods were unknown. A short questionnaire was emailed to nine painting conservators to find out more. Their responses varied greatly and only one conservator said that wax was their preferred fill material. The survey revealed that many conservators do not like using pigmented wax as a fill and are generally using softer wax mixtures than the formula made and used in the conservation program at Buffalo State College.

Benefits and negatives associated with pigmented wax/resin fills were identified and are listed below:

BENEFITS

- Moisture resistant
- Indefinite shelf life
- Good adhesive qualities
- Easily sculpted and textured
- Does not leave ghosting residues
- Pigmentation facilitates inpainting
- Relatively easy to reverse

DRAWBACKS

- Heat sensitive
 - May have solubility issues with some solvents*
 - May not be suited for matte paintings because wax does not absorb the glossy inpainting medium
 - Bloom may occur on surface
 - Takes time to make
- * This problem lessens with a high proportion of pigment

Table 1. Pigmented Wax/Resin Fill Formula Most Commonly Used in the Buffalo State College Art Conservation Paintings Department.

Components	Parts (by mass)
Wax 1: Beeswax	3
Wax 2: Be Square™195	1
Resin: Laropal® K-80	1
Pigments	5
Total Parts	10



EXPERIMENT

After researching different resins, the following were chosen as possible alternatives to Laropal® K-80: Regalrez® 1094, Laropal® A-81, and Paraloid™ B-72. Formulations were made, based on proportions in Table 1. A 1:1 ratio of raw umber and titanium white was used for pigment. Basic proportions of components remained the same as the original formula, but pigment quantities varied slightly, depending on the consistency desired. One formula was made without resin, to compare its properties.

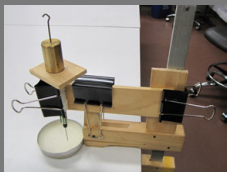
The following procedure describes how the formulas were made:

1. Beeswax was melted in a double boiler.
2. Microcrystalline wax was added and melted, followed by the resin, which dissolved.
3. Pigment was added slowly with mulling until the mixture had sufficient body, but was liquid enough to pour.
4. The mixture was poured into a silicone mold and leveled with a wooden tongue depressor.
5. Once cool, extra wax was removed from the mold and returned to the pot for reuse.
6. Sticks were removed from the silicone mold. Rather than bending, sticks should be hard and stiff, even brittle at room temperature. This quality is ideal because the wax fill should have similar mechanical properties as dried oil paint, in order to support stiff varnishes.



MODIFICATION OF FORMULA

Resin B-72 did not dissolve in the formula. This could be due to its relatively high molecular weight of 105,000 g/mol. Since B-72 did not work, consideration was given to replace beeswax in the formula with a microcrystalline wax such as Multiwax® W-445 or Cosmolloid 80H. To help make the choice, hardness tests were conducted. A needle penetrometer was not available, therefore, a simple apparatus was constructed for relative comparisons. Waxes were placed under a needle and calibration weights were placed on a platform above the needle. Measurements were made and recorded for Multiwax® W-445, Cosmolloid 80H, beeswax, and Be Square™ 195.



Multiwax® W-445 was the softest because the needle penetrated 25mm, with a 1000g weight. Conversely, Be Square™ 195 demonstrated to be the hardest, with a needle penetration of only 2mm with a 1000g weight. Beeswax and Cosmolloid 80H had comparable hardness, each at 5mm with a 1000g weight. A new formula was made using Cosmolloid 80H and Be Square™ 195 waxes with Regalrez® 1094 and pigments.

TESTING ON A PAINTING

Each wax/resin formula was tested on a donated painting. A dental tool was warmed and used to soften, compress, and level wax into the loss.



Excess wax was removed using a bamboo skewer. A warm, pre-made silicone mold was pressed onto the wax using a block of wood.

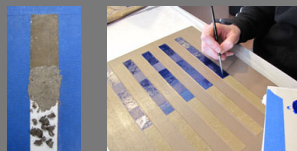


Molds can be made with various textures to match a variety of canvas weaves.



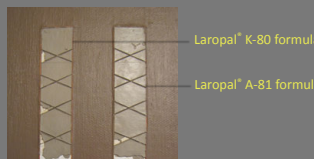
COMPATIBILITY TESTS

To test the compatibility of the wax/resin formulas to varnishes and inpainting media, a painted mock-up board was made with five vertical channels. The channels were primed with two coats of the following three varnishes, which were sprayed in horizontal bands: dammar, MS2A, and Paraloid® B-72. Each channel was filled with a different formulation, then the same varnishes were applied, followed by ultramarine blue inpainting media (PVA with ethanol diacetone alcohol, MSA with xylene, and Gamblin with isopropanol).



CROSS-CUT TESTS

Since the Laropal® A-81 formula seemed to best match the one with Laropal® K-80, cross-cut tests were performed on each with four trial runs.



RESULTS

Table 2. Physical and Working Properties

Pigmented Wax/Resin Fill	Physical and Working Properties
With Laropal® K-80	Semi-hard; Good consistency; Leveled well; Good adhesion; Textured well
With Laropal® A-81	Semi-hard; Good consistency; Leveled well; Good adhesion; Textured well
With Regalrez® 1094	Very hard; Good consistency; Difficult to level; Good adhesion; Did not texture well (shallow)
With no resin	Semi-hard; Brittle and crumbly; Leveled well; Poor adhesion; Did not texture well (shallow)
With Cosmolloid® 80H wax/Regalrez® 1094	Hard; Non-uniform pigment mixing; Fair consistency; Fair adhesion; Textured very well (deep impression)

When physical and working property comparisons were made between the wax/resins, there were no apparent differences between the formula containing Laropal® K-80 and the one with Laropal® A-81. The other formulas did not match the same standard (Table 2). The Laropal® A-81 formula also performed best in compatibility and cross-cut tests.

CONCLUSION

Resin Laropal® A-81 is a good replacement for Laropal® K-80 in the pigmented wax/resin formula, resulting in convenient wax sticks that:

- have good consistency
- can be applied, leveled, and removed easily
- can be embossed with textures
- have good adhesion
- become hard and brittle (like paint) when cool
- are compatible with varnishes/inpainting media

Note: Laropal® K-80 is a ketone resin and Laropal® A-81 is an aldehyde resin. They are both low molecular weight polymers.

An important note of caution: Waxes are flammable and will ignite if heated to their flash points. They should always be heated in a double boiler because the vapor above the boiling water will not go over 100° C. Beeswax has a flash point of 209° C.

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